EP350

Portable Radios

Detailed Service Manual

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SAFETY INFORMATION

Product Safety and RF Energy Exposure Compliance

These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.

ATTENTION!

This is restricted to occupational use only to satisfy ICNIRP RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your (Motorola Publication part number 68007024010) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, and other accessories, visit the following web site which lists approved accessories: http://www.motorola.com/radiosolutions

DOCUMENT HISTORY

The following major changes have been implemented in this manual since the previous edition:

Edition	Description	Date
6878422A01-A	Initial edition	Mar, 2009
6878422A01-B	Added VHF and UHF1 band information (Chapter 8, 9, 10, 11, 12, 13)	August, 2009

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Notations Used in This Manual

Throughout the text in this publication, you will notice the use of the following notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.

Note An operational procedure, practice, or condition that isessential to emphasize.

CAUTION indicates a potentially hazardous situation which, if not avoided, might result in equipment damage.

Summary of Printed Circuit Boards and Bands Available

Table below lists all the bands available in this manual.

Frequency Band	Bandwidth	Power Level	PC Board Part Number	Board Revision	Chapter
UHF2	435 – 480 MHz	1W or 4W	*8431BEACON200*	2	7
UHF2	–	–	*8421BEACON100*	1	7
UHF2	–	–	*8422BEACON100*	1	7
VHF	136 – 162 MHz	1W or 5W	*8431BEACON400*	4	10
VHF	–	–	*8421BEACON100*	1	10
VHF	–	–	*8422BEACON100*	1	10
UHF1	403 – 447 MHz	1W or 4W	*8431BEAUHF300*	3	13
UHF1	–	–	*8421BEACON100*	1	13
UHF1	–	–	*8422BEACON100*	1	13

Notes

Chapter 1 Maintenance

1.0 Introduction

This chapter of the manual describes:

- Preventive maintenance
- Safe handling of CMOS devices
- Repair procedures and techniques

NOTE The Servicing of your Intrinsically Safe Radios.
In order to maintain compliance, radios that are FM Approved to intrinsically safe standards MUST be repaired at FM audited service centers. See *Further Assistance From Motorola* on page 1-2 for more information.

1.1 Preventive Maintenance

Periodic visual inspection and cleaning is recommended.

1.2 Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. It is not recommended to inspect the interior electronic circuitry.

1.3 Cleaning

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the front cover, housing assembly, and battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.

NOTE Internal surfaces should be cleaned only when the radio is disassembled for servicing or repair.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (100% by volume).

CAUTION: The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosol sprays, tuner cleaners, and other chemicals should be avoided.

1. Cleaning External Plastic Surfaces
   The detergent-water solution should be applied sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. A soft, absorbent, lintless cloth or tissue should be used to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

2. Cleaning Internal Circuit Boards and Components
Isopropyl alcohol may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. Upon completion of the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

NOTE Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

1.4 Safe Handling of CMOS and LDMOS

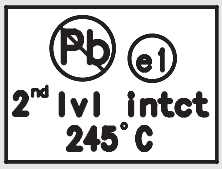
Complementary metal-oxide semiconductor (CMOS) devices are used in this family of radios. CMOS characteristics make them susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

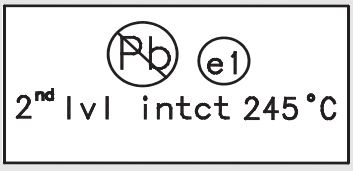
Handling precautions are mandatory for CMOS circuits and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the CMOS CAUTION paragraph in the Disassembly and Reassembly section of the manual.

1.5 General Repair Procedures and Techniques

NOTE Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards - examples shown below) were developed and assembled using environmentally preferred components and solder assembly techniques that meet or exceed compliance to the European Union's ROHS and WEEE directives **(Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC** and **Restriction of Hazardous Subtances (ROHS) Directive 2002/95/EC).** To maintain product compliance and reliability, use only the Motorola specified parts in this manual.

For the identification of lead (Pb) free assemblies, all EPP products will carry the EPP Marking, shown below, on the printed circuit board (PCB). This marking provides information to those performing assembly, servicing and recycling operation on this product, adhering to the JEDEC standard #97. The EPP Marking takes the form of a label or marking on the PCB.





Any rework or repair on Environmentally Preferred Products must be done using the appropriate lead-free solder wire and solder paste as stated in the following tables:

Table 1-1. Lead Free Solder Wire Part Number List

Motorola Part Number	Alloy	Flux Type	Flux Content by Weight	Melting Point	Supplier Part number	Diameter	Weight
1088929Y01	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7-3.2%	217C	52171	0.015”	1lb spool

Table 1-2. Lead Free Solder Paste Part Number List

Motorola Part Number	Manufacturer Part Number	Viscosity	Type	Composition & Percent Metal	Liquid Temperature
1085674C03	NC-SMQ230	900-1000KCPs Brookfield (5rpm)	Type 3 (-325/+500)	(95.5%Sn-3.8%Ag-0.7%Cu) 89.3%	217°C

Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement component is not locally available, check the parts list for the proper Motorola part number and order the component from the nearest Motorola Communications parts center listed in the “Piece Parts” section of this manual.

Rigid Circuit Boards

The family of radios uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The through-plated holes may interconnect multiple layers of the printed circuit. Therefore, care should be exercised to avoid pulling the plated circuit out of the hole.

When soldering near the connector pins:

- Avoid accidentally getting solder in the connector.
- Be careful not to form solder bridges between the connector pins
- Closely examine your work for shorts due to solder bridges.

Chip Components

Use the RLN4062 Hot-Air Repair Station for chip component replacement. Adjust the temperature control to 390 °C (735 °F), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

- **To remove a chip component**:

  1. Use a hot-air hand piece and position the nozzle of the hand piece approximately 0.3 cm (1/8") above the component to be removed.
  2. Begin applying the hot air. Once the solder reflows, remove the component using a pair of tweezers.
  3. Using a solder wick and a soldering iron or a power desoldering station, remove the excess solder from the pads.

- **To replace a chip component using a soldering iron**:
  1. Select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads.
  2. Using a pair of tweezers, position the new chip component in place while heating the fresh solder.
  3. Once solder wicks onto the new component, remove the heat from the solder.
  4. Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.
- **To replace a chip component using hot air**:
  1. Use the hot-air hand piece and reflow the solder on the solder pads to smooth it.
  2. Apply a drop of solder paste flux to each pad.
  3. Using a pair of tweezers, position the new component in place.
  4. Position the hot-air hand piece approximately 0.3 cm (1/8”) above the component and begin applying heat.
  5. Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

Shields

Removing and replacing shields is recommended to be done with the Air Blower, BOSCH GHG 603 or equivalent.

- **To remove the shield**:
  1. Place the circuit board in the circuit board holder.
  2. Add solder paste flux around the base of the shield.
  3. Position the heat-focus head onto the shield.
  4. Turn on the heater and wait until the shield lifts off the circuit board.
  5. Once the shield is off, turn off the heat, and grab the part with a pair of tweezers.
  6. Remove the circuit board from the circuit board holder.
- **To replace the shield:**
  1. Add solder to the shield if necessary, using a micro-tipped soldering iron.
  2. Next, rub the soldering iron tip along the edge of the shield to smooth out any excess solder. Use solder wick and a soldering iron to remove excess solder from the solder pads on the circuit board.
  3. Place the circuit board back in the circuit board holder.
  4. Place the shield on the circuit board using a pair of tweezers.
  5. Position the heat-focus head over the shield.
  6. Turn on the heater and wait for the solder to reflow.
  7. Once complete, turn off the heat, raise the heat-focus head and wait approximately one minute for the part to cool.
  8. Remove the circuit board and inspect the repair. No cleaning should be necessary.

Chapter 2 Test Equipment, Service Aids, and Service Tools

2.1 Test Equipment

Table 2-1 lists test equipment required to service the radios.

Table 2-1. Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2600 series or HP 8920A	System analyzer	This item will substitute for items with an asterisk (*)	Frequency/Deviation meter and signal generator for wide-range troubleshooting and alignment
*R1074A	Fluke 87 digital multi-meter	True RMS metering, 200 kHz frequency counter, 32-segment bar graph with backlit display	Digital voltmeter is recommended for AC/DC voltage and current measurements
	Fluke 85 RF probe	500 MHz, 30 VAC max	Use with Fluke 87 digital multi-meter for RF voltage measurements.
*R1377A	AC voltmeter	1 mV to 300 mV, 10 mega-Ohm input impedance	Audio voltage measurements
R1611A	Dual channel 100 MHz oscilloscope (Agillent)	Two-channel, 100 MHz bandwidth, 200 M sample rate/sec, 2 MB memory/ channel	Waveform measurements
S1339A	RF millivolt meter	100 μV to 3V RF, 10 kHz to 1 GHz frequency range	RF level measurements
*R1013B or *R1370A	SINAD meter or SINAD meter with RMS	Without RMS audio voltmeter or With RMS audio voltmeter	Receiver sensitivity measurements

2.2 Service Aids

Table 2-2 lists the service aids recommended for working on the EP350 Series Radios. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 2-2. Service Aids

Motorola Part No.	Description	Application
PMDN4026_R	Flat Ceramic Tuning Tools (1.8mm)	Used for tuning the VCO.
PMDN4038_R	Knob Remover/Chassis Opener	Used to remove the front cover assembly.
PMDN4039_R	Crab Eye Nut Opener	Used to remove the crab eye nut.
PMDN4040_R[1]	Radio Test Box	Enables communication between the radio, test equipment and the computer's USB port.
PMDN4041_R	RF Adapter	Adapts radio's antenna port to BNC cabling of test equipment.
PMDN4044_R	T-Head Ceramic Tuning Tool	Used for tuning the VCO.
PMDN4053_R	Flat Ceramic Tuning Tools (0.9mm)	Used for tuning the VCO.
PMDN4076_R	Radio to Radio Cloning Cable	Allows a radio to be duplicated from a master radio by transferring programmed data from the master radio to the other.
PMDN4077_R	Programming Cable	Used to program the radio through Customer Programming Software and Radio Tuner.
PMDN4079_R	GND Plate	Interconnects radio's chassis to RF Adaptor.
PMDN4080_R	Battery Eliminator	Interconnects radio to power supply.
PMVN4161_	Customer Programming Software on CD Rom	Program customer option and channel data.
PMVN4165_	Tuner on CD Rom	Only Motorola Service Centers or Authorized Motorola Service Dealers can perform this function.

Note: 1.Use PMDN4040BR or higher for tuning the EP350 Series radios as PMDN4040AR cannot be used to perform this function.

Programming/Test Cable

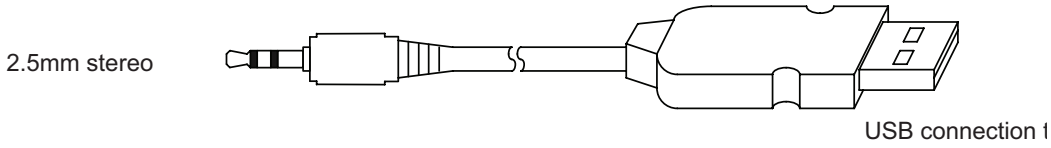


Figure 2-1. Programming/Test Cable (PMDN4077_R)

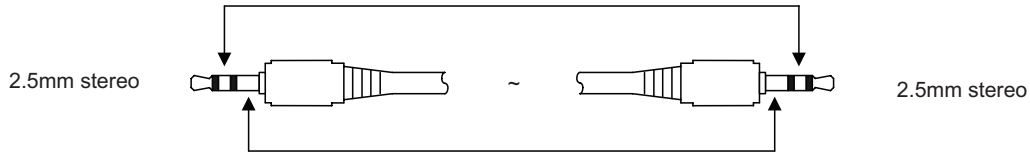


Figure 2-2. Cloning Cable (PMDN4076_R)

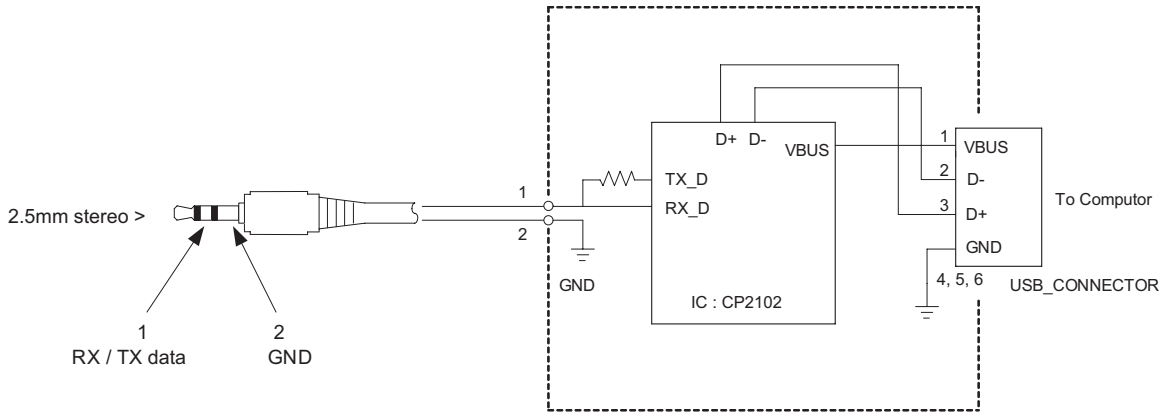


Figure 2-3. Wiring of the Connectors

Notes

Chapter 3 DC Power Distribution

3.1 DC Regulation and Distribution

A block diagram of the DC power distribution throughout the radio is shown in Figure 3-1.

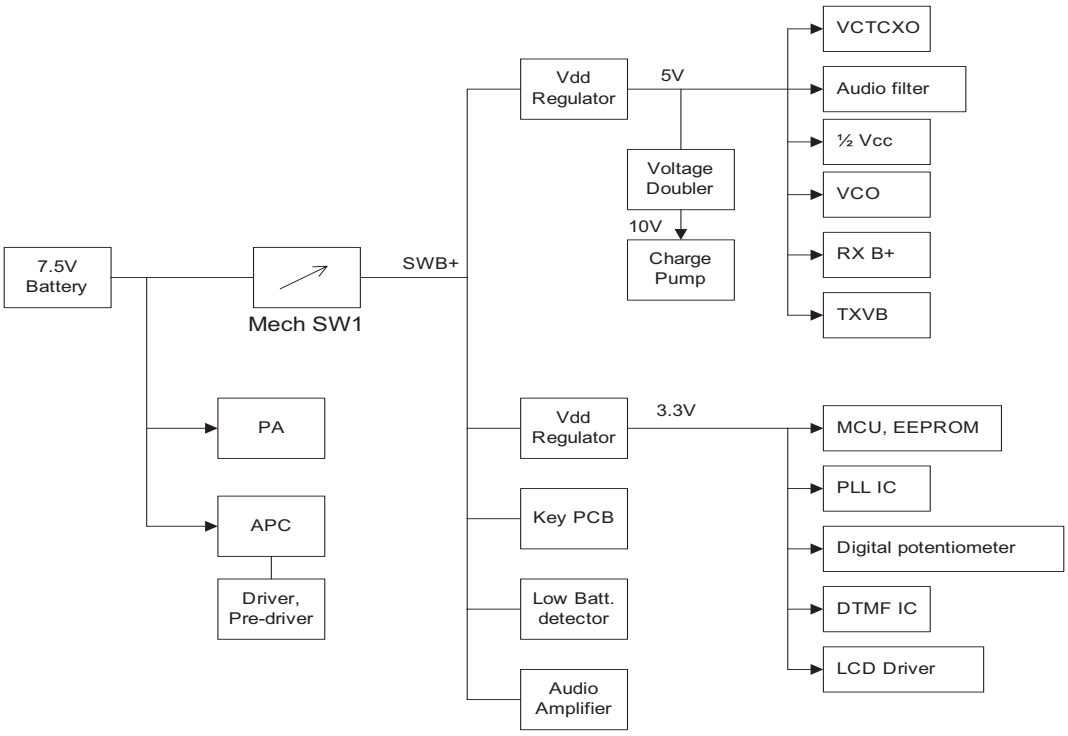


Figure 3-1. DC Power Distribution Block Diagram

Battery voltage enters at connector J602 and is routed through SW/VOL1 to become SWB+.

This voltage is routed to:

- SW/VOL1
- TX power amplifier Q403 (via R417)
- APC circuit U401
- RX audio power amplifier U601
- 5V regulator (U505)
- 3.3V regulator (U506)
- Voltage divider R153/R154, a microprocessor A/D input which measures battery voltage
- Key PCB

The following regulators are used:

Table 3-1. Voltage Regulators

Reference No.	Description	Type
U505	5V regulator	TK11250
U506	3.3V regulator	TK11233
U507	Voltage Doubler (10V)	TC12140

The 5 V source from U505 is applied to:

- RX back end circuitry
- RX/TX audio filters
- 1/2 VCC generator
- VCO power source (Q705, Q706)
- RX B+ (Q304)
- TXVB (Q407)
- VCTCXO

The 5 V source is also applied to transistor switches Q304 and Q407. Q304 is turned on by Q305 when RX_EN (from U101 Pin 71) is high, and supplies the source to mixer, IF IC and LNA. Q407 is turned on by Q408 when TX_EN2 (from U101 Pin 85) is high, and supplies the "TXVB" source to the first transmitter stage Q401 base, Q402 gate, APC power source (U401 Pin 8) and ANT switch (CR401).

The 3.3 V regulated source from U506 is applied to:

- MCU IC U101
- EEProm IC U104
- DTMF IC U103
- Audio processor IC U102
- Microphone bias circuitry
- And applied to Key PCB (LCD driver power source)

The 10 V source from U507 is applied to Charge Pump.

Chapter 4 Controller Theory of Operation

4.1 RX Audio Circuit

The RX audio circuit consists of Audio Processor IC, Audio Amplifier, Internal (INT)/External (EXT) speaker and Sub-Audio Tones System.

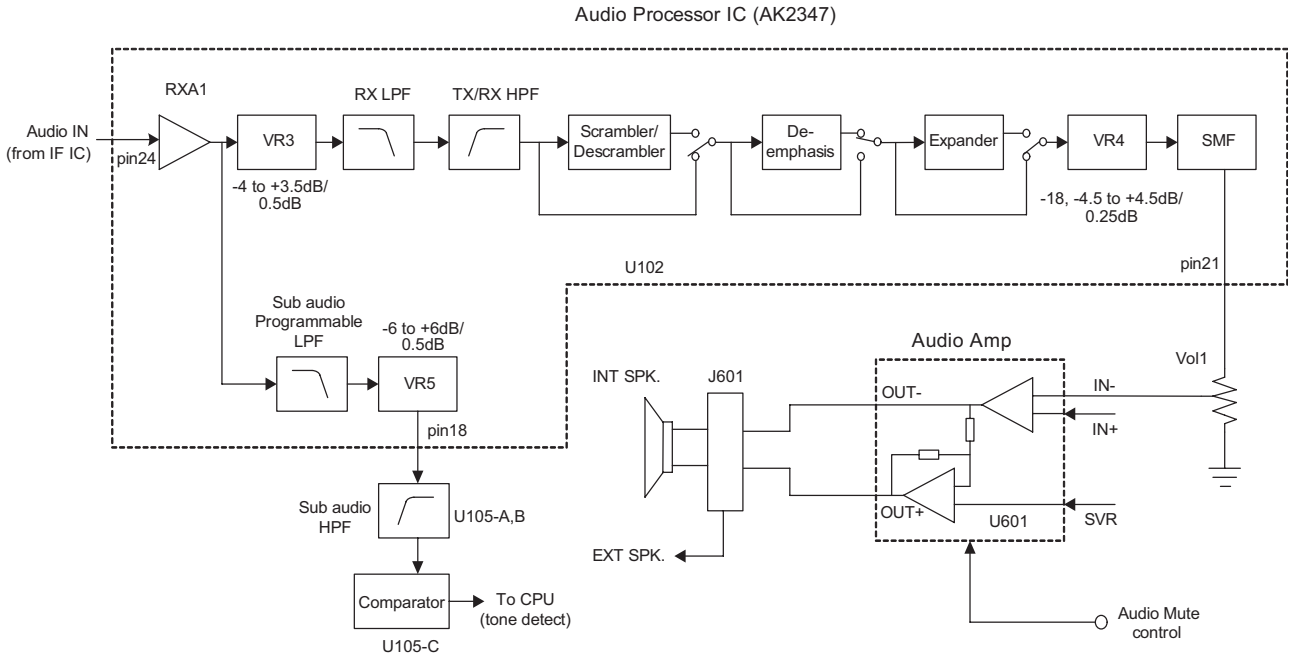


Figure 4-1. RX Audio Circuit

4.1.1 Audio processor IC (U102)

The RX audio from Pin 9 of U201 enters to Pin 24 of Audio processor IC.

- **RX A**: An operational amplifier used for gain adjustment of the receive demodulation signal from Pin 9 of U201. The gain is unity and it acts as a buffer amplifier.

4.1.1.1 RX Audio Processing

- **VR3:** This circuit controls the volume for adjusting the input level of receive demodulation signal. Adjustment range: -4.0dB to +3.5dB in 0.5dB steps.
- **RX LPF:** Low-pass filter to eliminate high-frequency components higher than 3 kHz which are included in the receive demodulation signal.
- **TX/RX HPF:** High-pass filter to eliminate low-frequency components lower than 250 Hz which are included in receive audio signal. This circuit is turned on and off by control register of Audio processor IC.
- **Descrambler:** This circuit inverts the spectrum distribution of receive audio signals with respect to the carrier frequency. The carrier frequency is 3.388 kHz or 3.290 kHz.

- **De-emphasis:** This circuit restores the original state of signal of which high-frequency component has been emphasized by the pre-emphasis.
- **Expander:** This circuit expands the signal compressed twice by the Compressor in dB scale to restore the original signal state.
- **VR4:** This circuit controls the volume for adjusting the RX output level. Adjustment range: -18.0dB, -4.5dB to +4.5dB in 0.25dB steps.
- **SMF:** Smoothing filter to eliminate the high-frequency and clock components generated in the Audio processor IC.

4.1.1.2 RX Tone PL/Digital PL Decode Filtering

- **Sub-audio Programmable LPF:** Low-pass filter to eliminate components of the RXA1 signal. This circuit is controlled by the internal registers and by the audio processor IC for cut-off frequency.
- **VR5:** This circuit controls the volume for adjusting the output level from the sub-audio LPF signal. Adjustment range: -6.0dB, +6.0dB in 0.5dB steps

The sub-audio tone of U102 Pin 18 output pass through switchable high-pass filter U105. This filter (U105-A, B) has 4 different high pass cut-off frequencies which can be selected accordingly to the sub-tone audio. This filter (U105-A, B) filters the unwanted sub-tone. The tone of U105-B output passed through U105-C comparator, which acts as a squaring circuit. This output signal is then sent to microprocessor Pin 3. The micro-processor then decodes CTCSS and CDCSS from this square signal.

4.1.2 Audio Amp

The de-emphasized audio signal from Pin 21 of audio processor IC passes through volume control (SW/VOL1) and is amplified by U601BTL audio amplifier to a sufficient level to drive a loud speaker. U601 has mute/un-mute function controlled by audio-mute control (Pin 83) of CPU. When U601 Pin 1 is low, the audio amp goes to active (un-mute) mode. When U601 Pin 1 is high, the audio amp goes to mute mode.

4.1.3 Internal and External Speaker

When no external speaker is plugged into J601, the RX audio is passed through to the internal speaker. When an external speaker is plugged into J601, the internal speaker is cut-off from the rest of the circuit and RX audio is passed through the external speaker.

4.2 TX Audio Circuit

The TX audio circuit consists of MIC/External MIC, LPF, Audio processor IC, and TX Sub-tone system. For UHF1 and UHF2, refer to Figure 4-2. For VHF, refer to Figure 4-3.

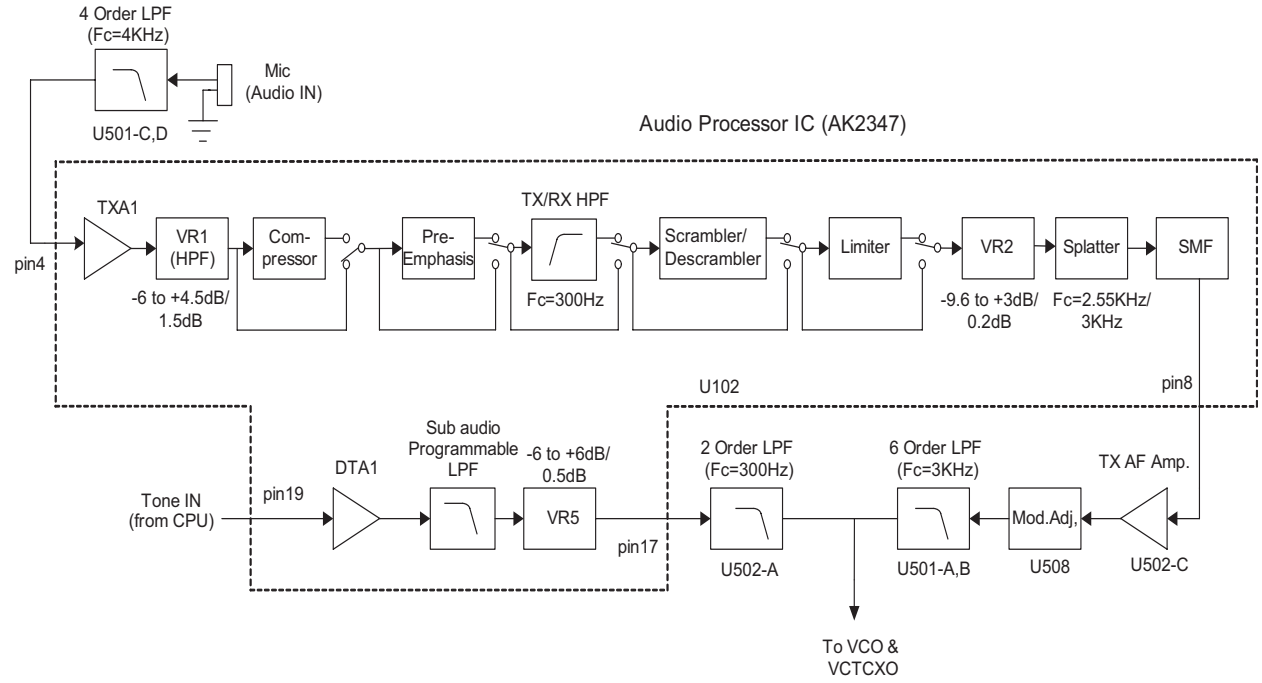


Figure 4-2. TX Audio Circuit (UHF1 and UHF2)

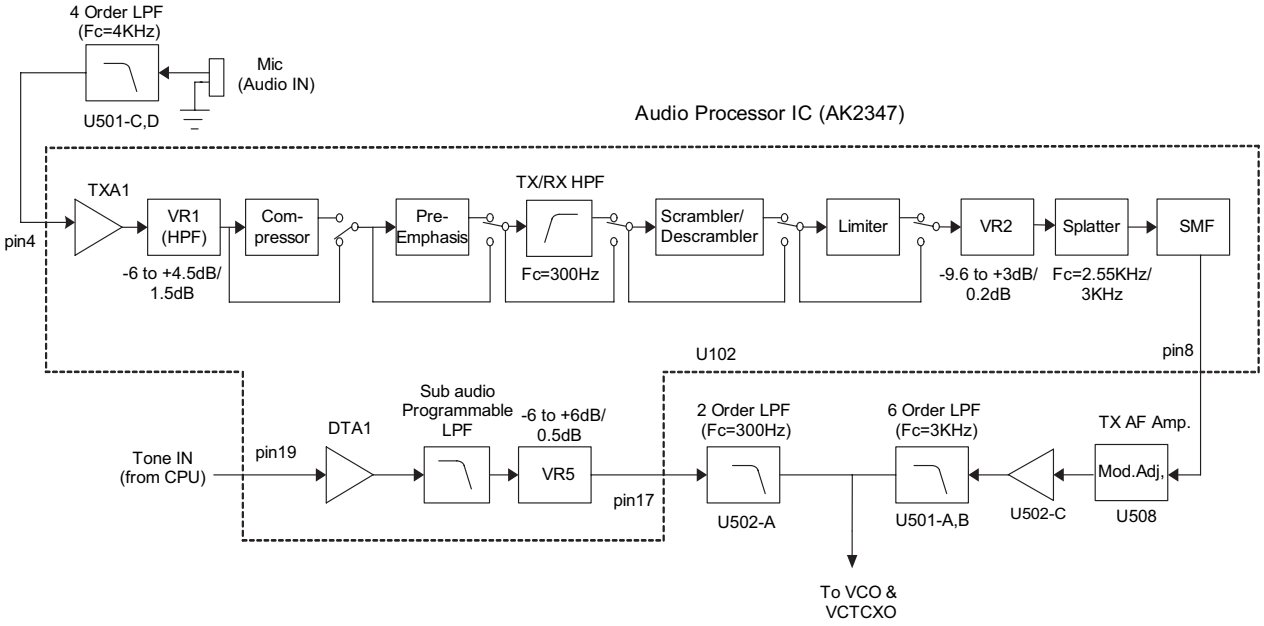


Figure 4-3. TX Audio Circuit (VHF)

4.2.1 MIC and External MIC

The TX audio enters the radio via the internal MIC or the external MIC jack. When using the internal MIC, the audio passes through the external jack then rest of the circuits. When using the external jack, the audio from the internal MIC is cut-off from the rest of the circuits and the external MIC audio is passed to the rest of the circuits.

4.2.2 4-order 4 kHz Low-Pass Filter (U501-C, D)

4-order 4 kHz Low-pass filter to prevent aliasing noise of the ASIC switching cut-off frequency.

4.2.3 Audio processor IC (U102)

4.2.3.1 TX Audio Processing

Tx Audio from Pin 14 of U501-D enters the ASIC at Pin 3, 4 (Internal TX AMP).

- **TX A1**: Operational amplifier for gain adjustment of TX audio signal. R102, R103, C102, C103 are used to set the gain.
- **VR1 (HPF)**: This circuit controls the volume for adjusting the input level of TX audio signal. Adjustment range: -6.0dB, +4.5dB in 1.5dB steps
- **Compressor**: This circuit compresses the amplitude of transmit audio signal by 1/2 in dB scale.
- **Pre-emphasis**: This circuit emphasizes the high-pass frequency component of TX audio signal to improve the S/N ratio of the modulation signal.
- **TX/RX HPF**: High-pass filter to eliminate low-frequency components lower than 250 Hz which are included in transmitter audio signal. This circuit is turned on and off by control register of Audio Processor IC.
- **Scrambler**: This circuit inverts the spectrum distribution of transmitter audio signals with respect to the carrier frequency. The carrier frequency is 3.388 kHz or 3.290 kHz.
- **Limiter**: Amplitude limiting circuit to suppress frequency deviation in the modulation signal. The limit level can be adjusted by applying a DC voltage the LIMLV Pin 7. When the pin is left open, the level predetermined within the device is output.
- **VR2**: This circuit controls the volume for adjusting the output level on the MOD Pin 8. Adjustment range: -9.6dB to +3.0dB in 0.2dB steps.
- **Splatter**: Low-pass filter to eliminate high-frequency components higher than 3 kHz which are included in the limiter output signal. The cut-off frequency is 3 kHz.
- **SMF**: Smoothing filter to eliminate the high-frequency and clock components generated in the ASIC.

4.2.3.2 Tx Tone PL/Digital PL Encode Filtering

The encode circuit of CTCSS and CDCSS mixes signals from 4 ports of microprocessor. This mixed signal passes through ASIC Pin 19, 20 (U102).

- **DTA1**: Amplifier for gain adjustment of sub-audio signal which generated from CPU. Use external resistor and capacitor to set the gain.
- **Sub-audio Programmable LPF**: Low-pass Filter to eliminate components of DAT1 signal in the transmitter. This circuit is controlled cut-off frequency by the internal ASIC registers.
- **VR5**: This circuit controls the volume for adjusting the output level from the Sub-Audio LPF signal. Adjustment range: -6.0dB to +6.0dB in 0.5 steps.

4.2.4 TX audio amplifier and 6 order 3 kHz Low-Pass filter

The TX audio signal from ASIC Pin 8 (UHF1, UHF2) or U508 Pin 4 (VHF) is linked by TX audio amp (U502-C) to increase limiting range. The limited audio signal is adjusted to a proper level by U508 and passes through 6 order 3 kHz low pass filter (U501-A,B) before being modulated.

4.2.5 TX modulation Adjustment

TX audio signal from Pin 8 of U502-C (UHF1, UHF2) or Pin 8 of ASIC (VHF) is linked TX modulation adjustment IC (U508). The TX modulation is tuned in the factory. If any of the TX part is replaced, the TX modulation must be tuned using Tuner.

4.3 Microprocessor Circuitry

The microprocessor circuitry includes microprocessor (U101) and associated EEPROM.

Table 4-1. Radio Memory Requirements

Reference No.	Description		Size
U101	Microprocessor	Flash ROM	128 Kbyte * 8
		RAM	5 Kbyte * 8
U104	Serial EEPROM		8 Kbit * 8

4.3.1 Memory Usage

Radio operation is controlled by software that is stored in internal Flash ROM memory. Radio parameters and customer specific information is stored in External EEPROM (U104). The operating status of the radio is maintained in RAM located within the microprocessor. When the radio is turned off, the operating status of the radio is written to EEPROM before operating voltage is removed from the microprocessor.

4.3.2 Control and Indicator Interface

Ports Pin 35 and 36 are outputs which control the Sub-PCB mounted LED indicator. When Pin 35 is high, the indicator is green. When Pin 36 is high, the indicator is red. When both are high, the indicator is amber. When both are low, the indicator id is off.

Pressing the side-mounted PTT button (PB501) provides a low to port Pin 44, which indicates PTT is asserted. Side-mounted function buttons 1 & 2 (PB502 and PB503) are connected to port Pin 21 and Pin 32, respectively.

4.3.3 Interface to USB programming

The radio can be programmed, or the programmed information can be read, using a computer with CPS (Customer Programming Software) connected to the radio via a USB Programming cable (PMDN4077A). Connection to the radio is made via the microphone connector (part of accessory connector J601). The line connects the programming connect (J601 Pin 6) to port PRG/CLONE_RX (data into uP, Pin 34) and PRG/CLONE_TX(data out of uP, Pin 33).

4.3.4 Storage of Customer-Specific Information

Information that has been programmed using CPS, such as channel frequencies or selective signaling codes, etc, are stored in the external EEPROM, where it is retained permanently (unless reprogrammed) without needing DC power applied to the microprocessor.

4.3.5 Sensing of VOX operating

Port PTT2 (Pin 68) is used to detect the presence of VOX operating when externally connected accessories with VOX enabled. When port PTT2 is low, the VOX will start to operate.

4.3.6 Microprocessor Power-on reset Routine

On power-up, the microprocessor is held in reset until the digital 3.3V regulator (U506 Pin 4) provides a stable supply voltage. Once the digital supply reaches steady state and releases the reset line (U107 Pin 2), the microprocessor begins to start up. After reset release by all circuit, the software within the microprocessor begins executing port assignment, RAM checking, and initialization.

4.3.7 Microprocessor 7.3728 MHz Clock

The 7.3728 MHz clock signal (Pin 13, X-in) is provided from the FL101.

4.3.8 Battery indicator

Various battery types are available having different capacities. The radio can select different battery type by FPP (Front Panel Programming) or CPS. A voltage divided by R153 and R154. And EEPROM have a data for each battery types.

Chapter 5 435 – 480 MHz UHF2 Theory Of Operation

5.1 Introduction

This chapter provides a detailed theory of operation for the radio components. Schematic diagrams for the circuits described in the following paragraphs are located in Chapter 7 of this manual.

5.2 UHF2 Receiver

The UHF2 receiver design covers the frequency range of 435 – 480 MHz and it is a double conversion super heterodyne with 1st IF 45.1 MHz and 2nd IF 455 kHz. The receiver is divided into two major blocks, Front End and Back End as shown in Figure 5-1.

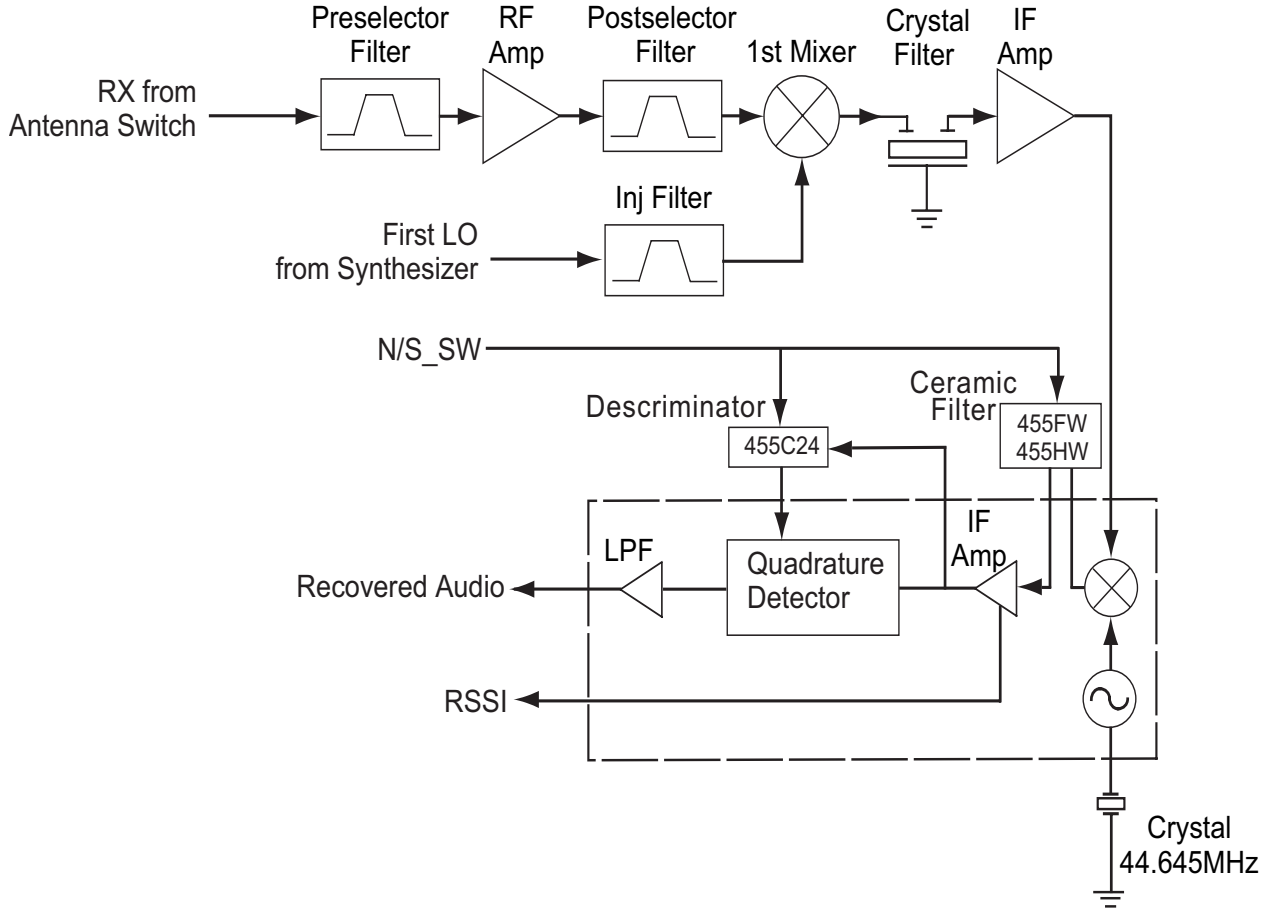


Figure 5-1. UHF2 Receiver Block Diagram

5.2.1 Receiver Front End

Incoming RF signals from antenna are first routed through the harmonic filter (L409, L410, L411, C426, C427, C428, C429, C445, C446) and antenna switch (CR301), part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of preselector filter, RF amplifier, post-selector filter and a single-balanced mixer.

The preselector filter is a varactor-tuned 2-pole design using discrete elements (L320, L324, C351, C352, C353, C354, C355, C356, C357, C358, C359, C360, C361) in a series/shunt resonator configuration. It is a band-shift filter and the frequency shift is controlled by varactor diodes CR314 and CR307, which are connected to the microprocessor. It is configured to provide steeper attenuation above the passband for improved spurious rejection when low-side local injection is used. The frequency is separated into 8 steps and controlled by CPU (435 – 480 MHz).

The output of this filter is matched to the base of RF amplifier Q301 which provides 13dB of gain.

The output of the RF amplifier is applied to the post-selector filter. The post-selector filter designed using discrete elements (L322, L323, L328, C379, C354, C355) in a series/shunt resonator configuration. It is a band-shift filter and the frequency shift is controlled by varactor diodes CR313, CR304 and CR305, which are connected to the microprocessor. It is configured to provide steeper attenuation above the passband for improved spurious rejection when low-side local injection is used. The frequency is separated into 8 steps and controlled by CPU (435 – 480 MHz).

The output of the post selector is connected to the single-balanced mixer consisting of components L329, L333, Q306 and Q307. 1st local signal generated from VCO is filtered by injection filter (L310, L331, C325, C326, C327) to remove second harmonics. The converted 1st IF frequency at mixer passes through L331 and matches the 45.1 MHz IF signal to pair crystal filter (FL301).

5.2.2 Receiver Back End

The 1st IF signal is amplified about 15 dB by IF amp Q303. The output of the IF amp is connected to IF IC (U201). 1st IF frequency (45.1 MHz) and 2nd LO frequency (44.645 MHz) are mixed in U201. The second mixer converts the 45.1 MHz high IF frequency to 2nd IF frequency (455 kHz).

Additional IF selectivity is provided by two ceramic filters (CF1, CF2). The wider filter 455 FW is used for 25 kHz channel spacing, and the narrower filter 455 HW is used for 12.5 kHz channel spacing. These two ceramic filters may eliminate undesired signal and demodulated by demodulator in U201. N/S_SW which connected to microprocessor is used to select the wide and narrow band.

The mute (squelch) circuit switches off the audio amplifier when no audio is present. The squelch circuit consists of U201 and U202 and their associated components. The noise signal from Pin 9 of U201 is used to control the squelch circuit sensitivity of U202. The noise passes through filter, and is amplified by internal amp of U201. The amplified noise act as a DC voltage to control the mute system. So if the noise level is under the threshold voltage, the microprocessor (U101) un-mutes the radio. If the noise level is over the threshold voltage, the microprocessor mutes the radio.
The squelch level is tuned in the factory. When a component or a part in the RX system is replaced, the squelch must be re-tuned using the Tuner.

5.3 UHF2 Transmitter

The UHF2 transmitter covers the range of 435 – 480 MHz. Depending on model, the output power of the transmitter is switchable on a per-channel basis between high power (4 Watts) and low power (1 Watt). The transmitter is divided into four major blocks as shown in Figure 5-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control.

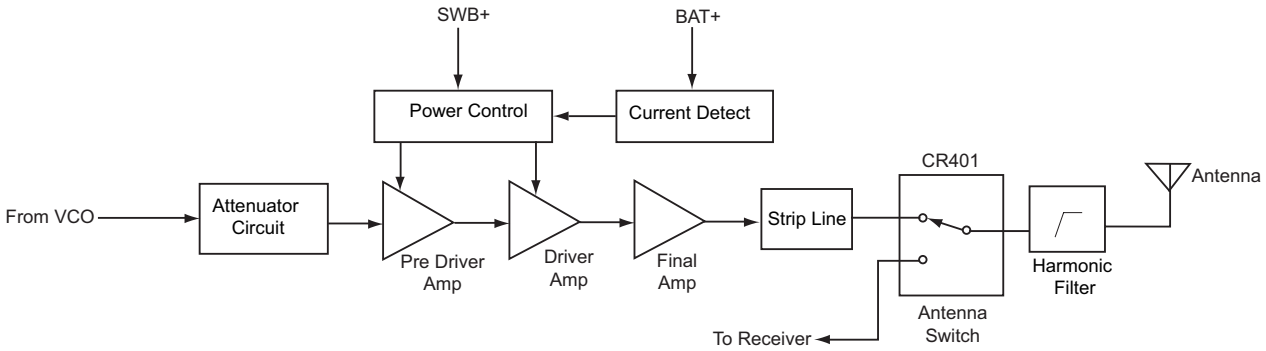


Figure 5-2. UHF2 Transmitter Block Diagram

5.3.1 Power Amplifier

The transmitter power amplifier has three stages of amplification – Pre Driver (Q401), Driver Amp (Q402) and Final Amp (Q403). Signal from TX VCO is applied to the pre driver via an attenuator circuit. The attenuator is pie style resistor attenuator, and is used as isolation between VCO and the power amps. The -4dBm TX RF signal from attenuator is then amplified by pre driver and driver amp to around +25dBm and is applied to the final amp. The final amp (Q403) is an enhancement-mode N-channel MOSFET device providing a gain of 12dB. The device drain current is drawn directly from the DC battery supply voltage input via L413. A matching network consisting of C416 to C420 and a strip line, transforms the impedance to approximately 50 Ohm.

5.3.2 Antenna Switch

An antenna switch works mainly as a switching device between transmit and receive paths. In transmit mode (PTT), Q407 is turned on and both PIN diodes (CR401, CR301) are forward biased into conduction. This enables the RF signal to pass to the harmonic filter and then to the antenna. In the receiver mode, both diodes are off. Signals applied to the antenna jack are routed via the LPF (harmonic filter), through network L409 to L411, to the receiver input.

5.3.3 Harmonic Filter

The harmonic filter consists of components L409, L410, L411, C426, C427, C428, C429, C430, C445 and C446. The harmonic filter is a seven-pole Chebychev filter.

5.3.4 Auto Power Control

The APC keeps the current supply constant to the final amp (Q403). The drain current of Q403 (final amp) is sensed across resistor R417. The voltage difference across R417 is amplified through U401 by the ratio of R423 to R417. The differential signal at the output of U401 (Pin 7) is passed to Q404 and Q405 that produces a constant power output to the antenna. If the current is changed due to change of battery voltage or load, APC controls gate voltage of Q403 and collector voltage of Q401 and drain voltage of Q402 to keep TX power stable. This circuit stabilizes TX power at a pre-determined level adjusted by U402. This bias voltage is tuned in the factory. If the transistor (Q403) is replaced, the RF Output Power must be tuned. By tuning the RF output power, the bias voltage will be tuned through U402. Extra care has to be taken during the tuning process. Do not exceed the maximum allowed bias voltage.

5.4 UHF2 Frequency Generation Circuitry

The PLL synthesizer subsystem consists of the reference oscillator (VCTCXO), VCO, PLL IC, Charge Pump and Loop Filter.

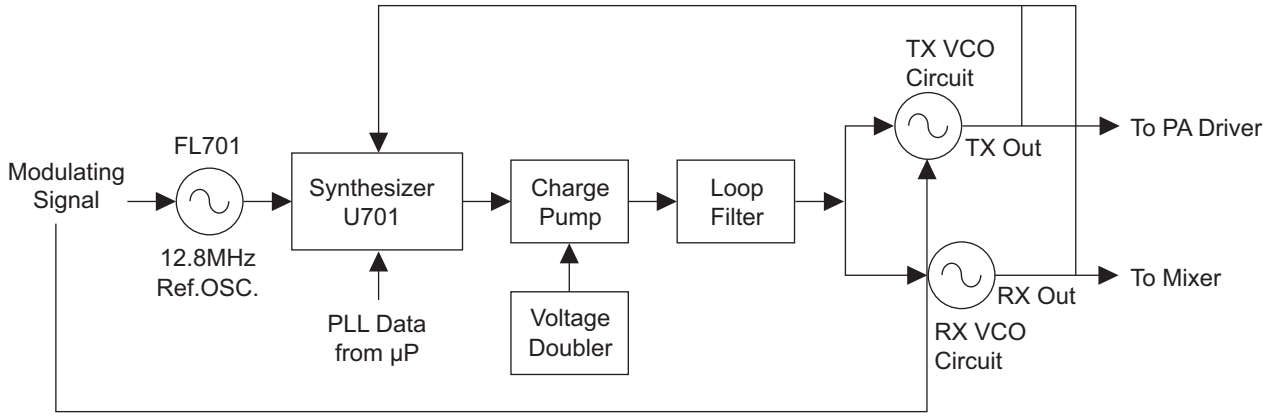


Figure 5-3. UHF2 Frequency Generation Unit Block Diagram

5.4.1 Reference Oscillator (12.8 MHz VCTCXO)

The reference oscillator is powered by regulated 5V provided by U505. The reference frequency 12.8 MHz VCTCXO (Voltage Controlled Temperature Compensated Crystal Oscillator) is applied to the PLL IC (U701) via Pin 1. Main frequency can be adjusted by chip trimmer of VCTCXO. This frequency provides reference to the PLL IC and has a frequency stability of +/-2.5PPM (max) at the temperature ranging from -30 to +60 Degree Celsius.

5.4.2 PLL IC Prescaler and Comparator

The reference frequency from VCTCXO is divided to 6.25 kHz or 5 kHz by reference counter, R. The RF signal input from the VCO is divided to by prescaler (1/64), divided by N and A counters in PLL IC to determine frequency steps and then supplied to the comparator. The comparison frequency is 6.25/5 kHz. The internal phase comparator compares the phase difference between the reference and VCO signal. When the phase of the reference frequency is leading, Pin15 (R) is the output. When VCO frequency is leading, Pin 16 (P) is the output. When P=R, small pulses are the output of the phase detector.

5.4.3 Voltage Doubler and Charge Pump

The voltage doubler (U507) converts 5V to 10V and is applied to the charge pump circuitry. The charge pump is used for charging output signals P, R supplied by PLL IC from 0-3.3V to 0-10V. This voltage is used to drive the VCO.

5.4.4 Loop Filter

The loop filter contains C751, C752, C753, C754, R726, R727, R728. It reduces the residual side-band noise to get the best signal-to-noise ratio. The output signal from loop filter is applied to VCO.

5.4.5 Dual VCO

The dual VCO module contains a RX VCO and a TX VCO. They are configured as colpitts oscillators and connected to power up through transistor switches. Only one VCO is selected at a time. A steering line voltage between 0.35V and 9.7V at varactor CR701 tunes the full RX frequency range from 389.9MHz to 434.9MHz, and varactor CR702 tunes the full TX frequency range from 435MHz to 480MHz.

In Receiver mode, high signal of RX_EN from Pin 71, U101 activates Q305. When Q305 is activated, current flows through the base of Q304 and thus activates the Q705. The varactor CR701 sets the resonance frequency. When there is a change in voltage supplied by loop filter, there is a change in the resonance frequency. L703 is the resonating coil, which forms the tank circuit together with variable cap C710.

In Transmit mode, high signal of TX_EN1 from Pin 84, U101 enables current flows through collector of Q503 and thus activates Q706. The varactor CR702 sets the resonance frequency. When there is a change in voltage supplied by loop filter, there is a change in the resonance frequency. L706 is the resonating tuning coil, which forms the tank circuit together with variable cap C722.

5.5 Keypad

Left, Right and P1 to P3 keys are directly connected to microprocessor via 22 pin connector. When any of these keys is pressed, the voltage goes "low" and microprocessor detects it.

For full keypad models, the number keys are in matrix type which consisted of 3 rows and 4 columns. When any of these keys is pressed, the voltage goes "low" and microprocessor interprets the voltage for each key press.

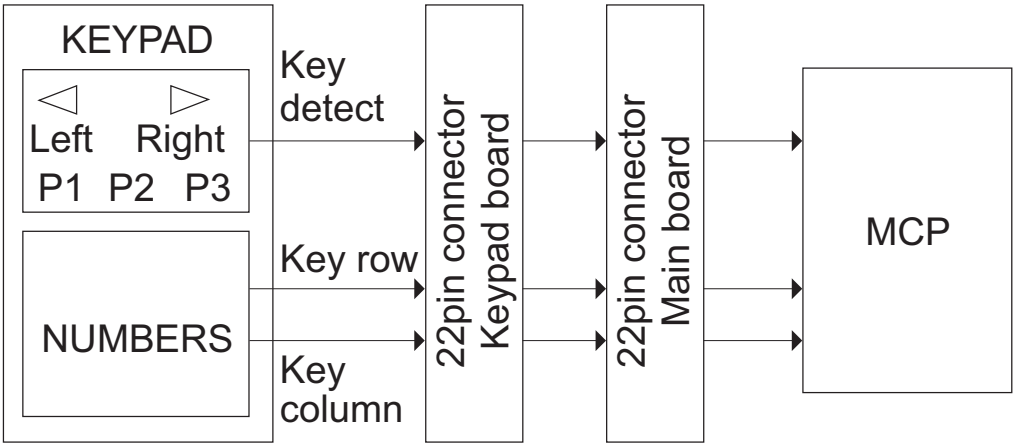


Figure 5-4. Keypad Block Diagram

Chapter 6 UHF2 Troubleshooting Tables

6.1 Troubleshooting Table for Receiver (UHF2)

Table 6-1. Troubleshooting Table for Receiver (UHF2)

Symptom	Possible Causes	Procedure	Corrective Action
Radio Dead (no turn–on beep, no LED indication)	1. Battery dead or defective	Substitute good battery or battery eliminator	Change or replace battery.
	2. Defective battery contacts	Inspect battery contacts for corrosion or bent terminals	Clean/Repair/Replace J602
	3. Microprocessor not starting up	Verify clock input to U101 Pin 13 is 7.3728 MHz using high impedance probe. Verify U101 Pin10(reset) is high.	Troubleshoot/Replace FL101. If reset is Low, troubleshoot regulator U506 or U107.
	4. Regulator fault	Verify U506 Pin 4 is 3.3V Verify U505 Pin 4 is 5.0V	Check for shorts on outputs Troubleshoot/Repair as needed, replace faulty regulator
	5. Flexible Cable fault	Check connection of the 12 pin flexible cable between J104 & J105	Re–assemble or replace flexible cable
No RX Audio (with LED indication)	1. Speaker dead or defective	Substitute a good housing (with speaker) Verify J603 connection	Change the housing (with accessory) Change the housing (with accessory)
	2. Audio Processor IC not starting up	Verify clock input U102 Pin 14 is 3.5795 MHz using high impedance probe.	Troubleshoot/Replace FL102
	3. Audio Amp IC not starting up	Verify U601 Pin 6 is battery voltage. If battery voltage is being supplied to Pin 6, then verify audio output at Pin 5 & 8.	Troubleshoot/Replace U601
No Receive (with no LED indication)	1. IF IC dead or fault	Verify clock input to U201 Pin 1 & 2 is 44.645Mhz using high impedance probe.	Troubleshoot/Replace FL201
No RX	1. RX–B+	Verify Q304's collector voltage is 4.8V when RX–EN is high.	Check/Replace Q304

6.2 Troubleshooting Table for Synthesizer (UHF2)

Table 6-2. Troubleshooting Table for Synthesizer (UHF2)

Symptom	Possible Causes	Procedure	Corrective Action
Synthesizer Out of Lock (No RX Mode)	1. Defective 12.8 MHz VCTCXO	Verify clock output FL701 Pin 3 is 12.8 MHz using high impedance probe.	Repair/Replace FL701
	2. 1/2VCC defective	Verify FL701 Pin 1, U502–B Pin 5 & U502–D Pin 14 voltage is 1.9V.	Troubleshoot: 1/2VCC circuitry
	3. No RX–Enable	Verify U101 Pin 71 (RX–EN1) is high. Verify Q304 collector voltage is approximately 4.7V in RX mode	Check U101 operating Troubleshoot: Q304 & Q305 circuitry
	4. Check PLL–LD port	Verify U101 Pin 27 is Low (Normal Mode) Verify U101 Pin 27 is swept from low to high (Power Save Mode)	Troubleshoot: PLL circuitry. Repair/Replace U701
Synthesizer Out of Lock (No TX Mode)	1. Defective 12.8 MHz VCTCXO	Verify clock output FL701 Pin 3 is 12.8 MHz using high impedance probe.	Repair/Replace FL701
	2. 1/2VCC defective	Verify FL701 Pin 1, U502–B Pin 5 & U502–D Pin 14 voltage is 1.9V.	Troubleshoot: 1/2VCC circuitry
	3. No TX–Enable	Verify U101 Pin 84(TX–EN1) is high when PTT is pressed. Verify Q407 collector voltage is approximately 4.7V when PTT is pressed (TX–EN2).	Check U101 operating Check U101–Pin 85 is high/ Replace Q407/check LK2 is short
	4. Check PLL–LD port	Verify U101 Pin 27 is Low (Normal Mode) Verify U101 Pin 27 is swept from low to high (Power Save Mode)	Troubleshoot: PLL circuitry Repair/Replace U701

6.3 Troubleshooting Table for Transmitter (UHF2)

Table 6-3. Troubleshooting Table for Transmitter (UHF2)

Symptom	Possible Causes	Procedure	Corrective Action
No internal Mic audio	1. Mic dead or defective	Verify audio present (~10mV rms) when speaking into Mic. Check bias of R194 (3.3V).	Replace Mic.
	2. Mic bias fault	Verify U101 Pin 78 is 1.1V when PTT button is pressed.	Check/Replace U101
	3. Audio Processor IC not starting up	Verify clock input U102 Pin 14 is 3.5795 MHz using high impedance probe.	Troubleshoot/Replace FL102
No EXT. Mic audio	1. J601 defective	Check connection with EXT mic	Check/Replace J601
	2. Audio Processor IC not starting up	Verify clock input U102 Pin 14 is 3.579545 MHz using high impedance probe.	Troubleshoot/Replace FL102
No transmit (No TX LED indication)	1.PTT switch defective	Verify U101 Pin 44 is low when PTT is pressed.	Replace PTT switch PB501
No transmit (TX LED indication OK)	1. Synthesizer out of lock	Refer to Table 6-2.	Check U101 operating
	2. No TX–Enable	Verify U101 Pin 84 (TX–EN1) is high when PTT is pressed. Verify Q407 collector voltage is approximately 4.7V when PTT is pressed (TX–EN2).	Check U101 Pin 85 is high/ Replace Q407/Check LK2 is short
Low Power	1. Low TX injection	Check the RF level at Q409 & C449 per schematic.	Troubleshoot Q409 circuitry & VCO bias
	2. R417 defective	Verify resistance is 0.1 Ohm	Replace R417.
	3. Incorrect control voltage	Verify Q404 collector voltage is approximately 5.5V in low frequency & high power.	Troubleshoot APC circuitry Replace Q404
	4. Q403 defective (High current)	Verify U401 Pin 7 is near 0V	Replace Q403
	5. Antenna switch defect	Verify CR401 anode voltage is approximately 1.4V	Check/replace CR401 & CR301
	6. Harmonic filter defective	Visually inspect components C426 – C429, C445, C446, C430	Repair/Replace if necessary
	7. Incorrect power tuning (this has to be performed only after item 1-6 has been checked)	Check conducted power	Re-tune power using tuner.
Poor TX range (Conducted power OK)	1. Defective or wrong Antenna.	Verify correct antenna is installed. Try using another antenna.	Replace antenna

6.4 Troubleshooting Table for Board and IC Signals (UHF2)

Table 6-4. Troubleshooting Table for Board and IC Signals (UHF2)

IC Designator	Pin	Pin Function	DC Voltage (V)	Comments (Condition)
U201(IF IC)	1	Osc1	3.9	44.645 MHz input
	2	Osc2	3.3	
	4	VCC	4.7	
	9	Audio frequency	1.2	
	12	RSSI out	Approximately 1	At –47dBm(with conducted)
	13	N–DET(BUSY)	Low	At busy
	15	GND	0	
	16	RF input	1	45.1 MHz input
U701(PLL IC)	1	Reference OSC input	1.4	12.8 MHz input
	4	VCC	3.3	
	6	GND	0	
	7	XF IN	2.2	
	8	F IN	2.2	
	12	Power save	High	
	13	GND	0	
	14	LD_out	High	If pll unlock is low
	15	@P	2.4	
	16	@R	Low	
U601	1	Mode (Mute con)	0	
(Audio Amp.)	2	SVR	3.8	
	3	IN+	3.8	
	4	IN-	3.8	
	5	OUT-	3.8	
	6	VCC	7.5	This voltage depends on Battery
	7	GND	0	
	8	OUT+	3.8	
U103	1	IN+	1.6	

Table 6-4. Troubleshooting Table for Board and IC Signals (UHF2) (Continued)

IC Designator	Pin	Pin Function	DC Voltage (V)	Comments (Condition)
(DTMF decoder)	2	IN-	1.6	
	3	GS	1.6	
	4	Vref	1.6	
	8	OSC1	1.6	3.579545 MHz input
	10	VSS	0	
	11	TOE	3.3	
	17	STD	High	At DTMF detecting
	18	EST	3.3	
	19	ST/GT	3.3	
	20	VDD	3.3	
FL701(VCTCXO)	1	VCON	1.9	
	2	GND	0	
	3	OSC out	osc	Generate the 12.8 MHz
	4	VCC	5	
Q206(N/S SW)	E	GND	0	
	B	N/S SW	12.5 kHz: Low	
	C	Collector	12.5 kHz: High 25 kHz: Low	
Q304	E	+5V	5	At RX Mode
	B	To Q305 collector	Low	
	C	RX_B+	4.7	
Q305	E	GND	0	At RX Mode
	B	RX_EN	High	
	C	To Q304 base	Low	
Q503	E	GND	0	At TX Mode
	B	TX_EN1	High	
	C	To Q706 base	Low	
Q407	E	+5V	5	At TX Mode
	B	To Q408 collector	Low	
	C	TXVB	4.7	
Q408	E	GND	0	At TX Mode
	B	TX_EN2	High	
	C	To Q407	Low	

Table 6-4. Troubleshooting Table for Board and IC Signals (UHF2) (Continued)

IC Designator	Pin	Pin Function	DC Voltage (V)	Comments (Condition)
Q601	E	GND	0	
	B	Audio_MUTE_CON	Mute: Low	
			None Mute: High	
	C	Mode	Mute: High	
			None Mute: Low	

1. All voltages are measured with a high-impedance digital voltmeter and expressed in volts DC relative to ground (0V).
2. Voltages are measured with a DC input voltage of 7.50 + .02 volts DC applied to the battery connector (J602).
3. All voltages are measured in the squelched receive mode, unless otherwise indicated.
4. Voltages are identical for VHF and UHF models unless otherwise indicated.

Chapter 7 UHF2 Schematic Diagrams, Overlays, and Parts Lists

7.1 Introduction

This section provides schematic diagrams, overlays, and parts lists for the radio circuit boards and interface connections.

7.1.1 Notes For All Schematics and Circuit Boards

* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

1. Unless otherwise stated, resistance values are in Ohms (K = 1000), capacitance values are in nanofarads (nF), picofarads (pF) or microfarads (µF), and inductance values are in nanohenries (nH) or microhenries (µH).
2. DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. If the board has been removed from the chassis, the transmitter module mounting screws may be used for ground connection. (*Note: The antenna nut bracket is connected to ground.*) Operating mode dependent voltages are followed by (RX) for receive mode, (TX) for transmit mode, (UNSQ) for unsquelched mode, etc.
3. RF voltages on VHF models are measured with a Fluke model 85 RF probe. The indicated voltages expressed in mV (RF) are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 1mV (-47dBm) RF signal applied to the antenna jack ANT1/ANT.
4. RF voltages on UHF models are measured both with a high–impedance RF voltmeter having a bandwidth in excess of 500 MHz (levels are expressed in dBm) and with a Fluke model 85 RF probe [levels are expressed in mV (RF)]. These indicated voltages are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms, and are only approximate for UHF frequency measurements. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 1mV (-47dBm) RF signal applied to the antenna jack ANT1/ANT.
5. Audio voltages are measured with a high-impedance AC rms voltmeter. The indicated voltages are expressed in mV rms. Receive mode voltages are followed by (RX) and are measured with an on-channel signal with 1 kHz modulation at 60% deviation (3 kHz for 25 kHz channels, or 1.5 kHz for 12.5 kHz channels). Transmit mode voltages are followed by (TX) and are measured with a 1 kHz, 10 mV rms signal present at the external microphone input (accessory connector J601).

6. Reference Designators are assigned in the following manner:

Ref. No. Series	Circuit Block
101 – 199	Microprocessor & audio control circuits
1001 – 1099	Microprocessor & audio control circuits
201 – 299	IF IC circuit
301 – 399	Front-end and 1st Mixer
401– 499	Transmit RF stage & Auto power control
501 – 599	Base band & generating circuit
601– 699	Audio amplifier
701– 799	VCO & PLL Synthesizer

7. Circuit Block Interconnection Legend:

Name	Description
+5V	5 Volts (Regulated)
+3.3V	3.3 Volts (Regulated)
SWB+	Switched Battery Voltage
BAT+	Unswitched Battery voltage
+10V	Digital 10V(Regulated)
RESET	Low-line reset signal fromU107 to U101 Pin 10
TX_EN1	Transmit enable signal from U101 Pin 84
TX_EN2	Transmit enable signal from U101 Pin 85
TXVB	TX operating voltage
TX_AF3	TX audio signal from audio processor IC to TX Audio filter
TX_SUB_TONE	TX sub tone signal from audio processor IC to TX modulation.
RX_B+	RX operating voltage
RSSI	RX signal strength indication from IF IC to U101
Busy	RX detect signal from IF IC to U101
FTV	RX frequency shift voltage
RX_AF1	RX audio signal from IF IC to Audio processor IC
PLL_LD	PLL lock detect signal from PLL IC to U101
N/S SW	Channel space selectable Switch (12.5 kHz/25 kHz)
1/2VCC	1.9 volts (divided by U502-D)

7.1.2 Four Layer Circuit Board

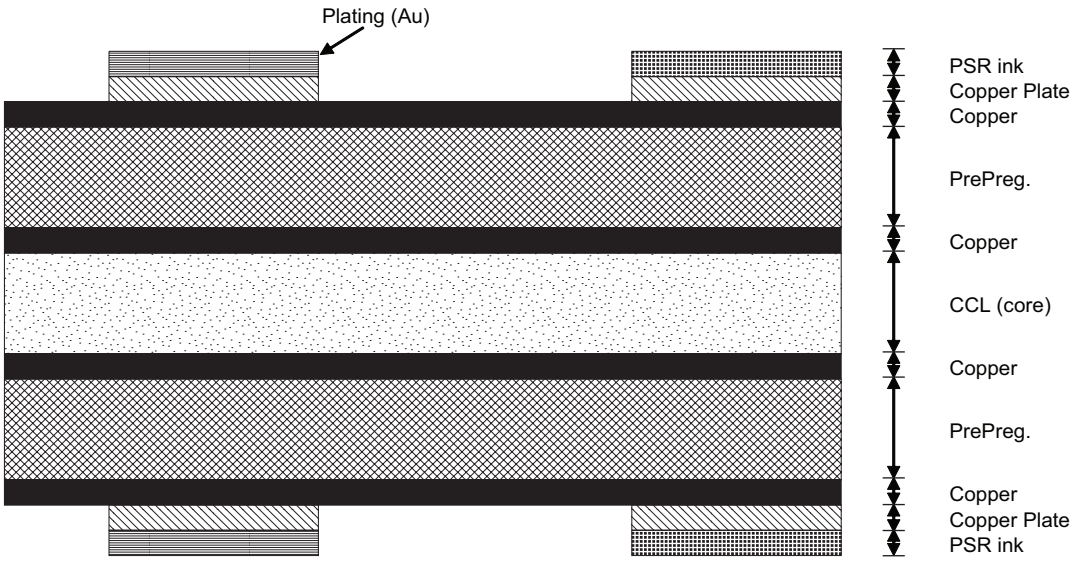


Figure 7-1. Four–Layer Circuit Board: Copper Steps in Layer Sequence

7.2 Speaker and Microphone Schematic

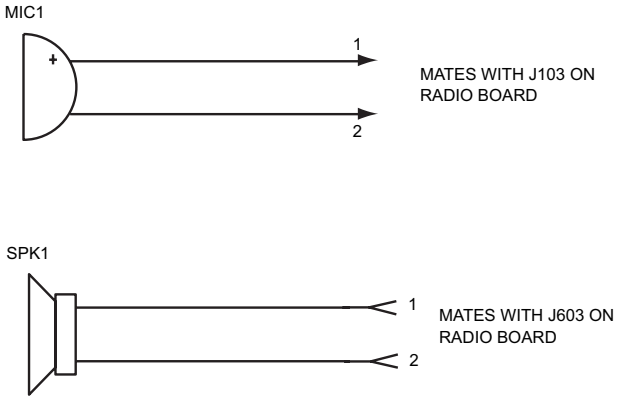


Figure 7-2. Speaker and Microphone Schematic

7.2.1 Speaker and Microphone Parts List

Reference Designator	Motorola Part No.	Description
MIC1	PMDN4139_R	Microphone
SPK1	PMDN4067BR	Speaker & Cable

7.3 Circuit Board/Schematic Diagram and Parts List (UHF2: 435–480 MHz)

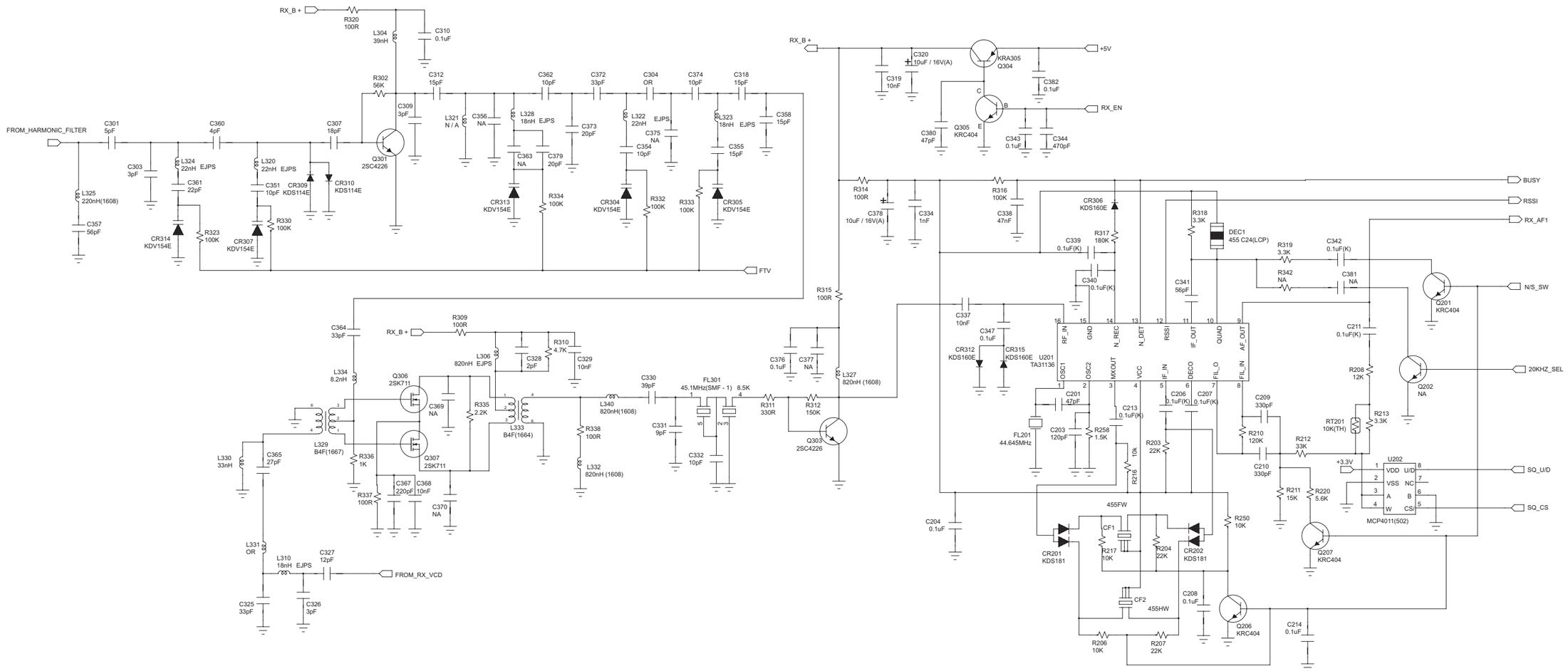


Figure 7-3. UHF2 (435–480 MHz) Receiver Schematic Diagram

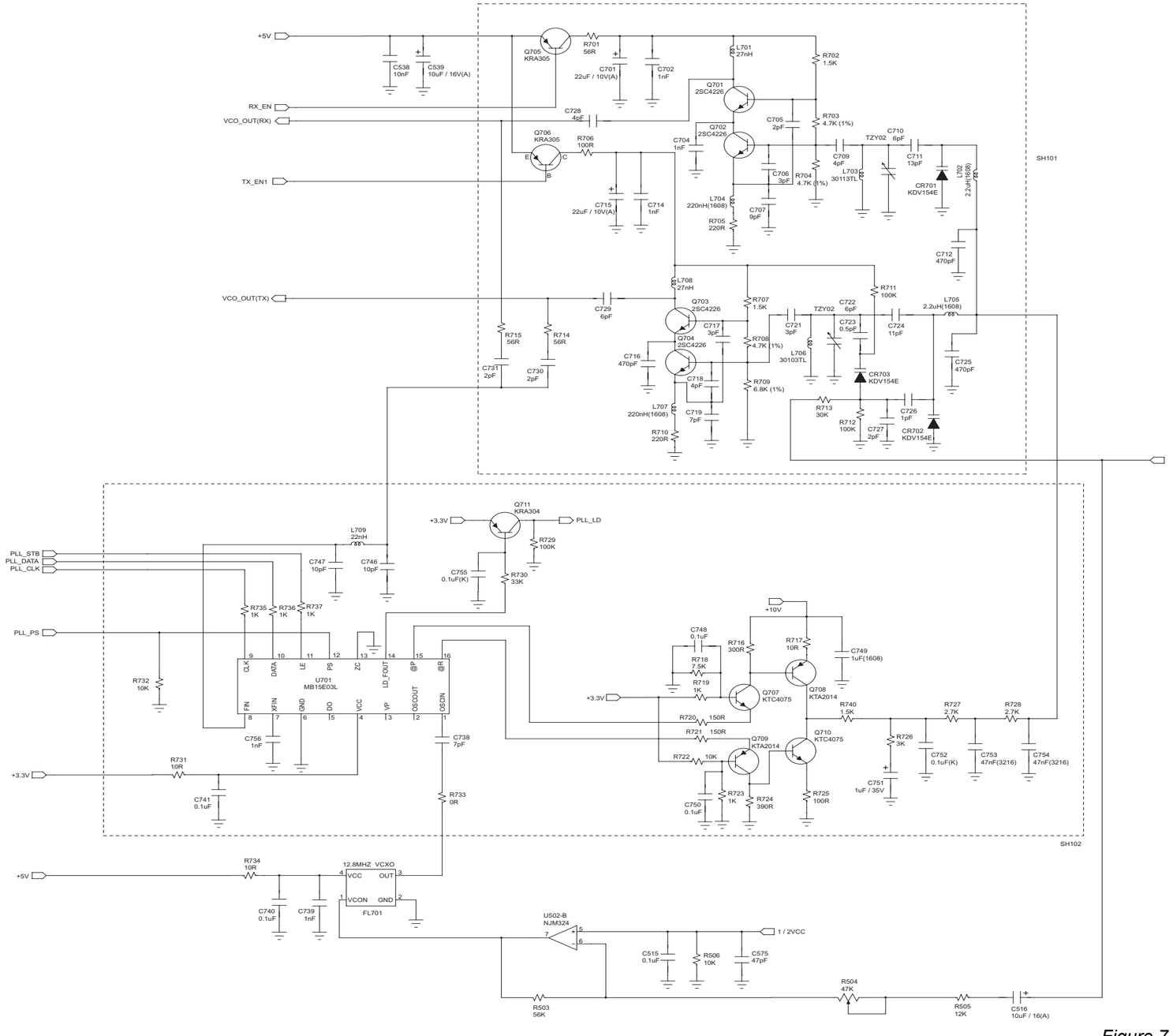


Figure 7-4. VCO and PLL Schematic Diagram

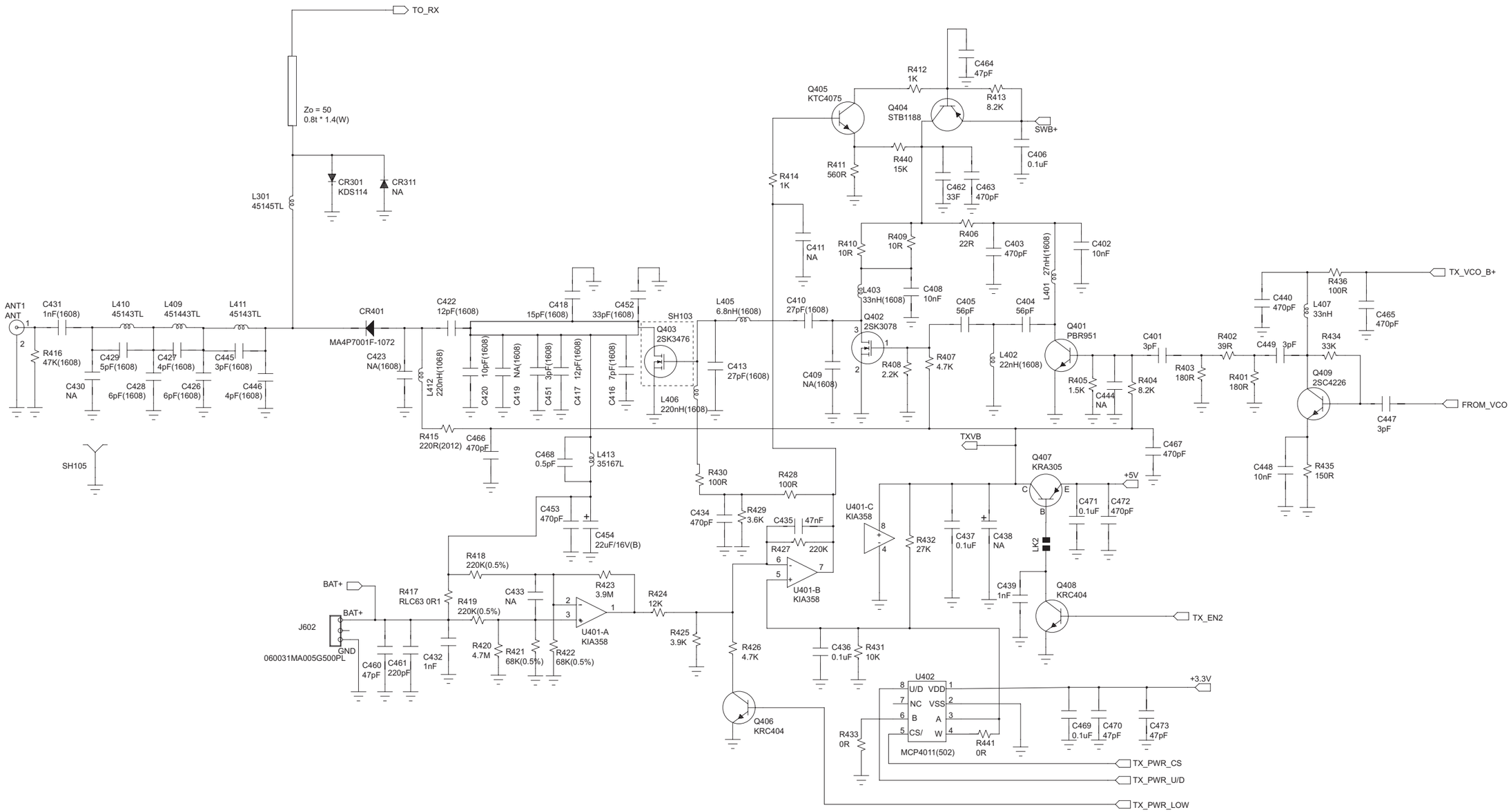


Figure 7-5. Transmitter Schematic Diagram

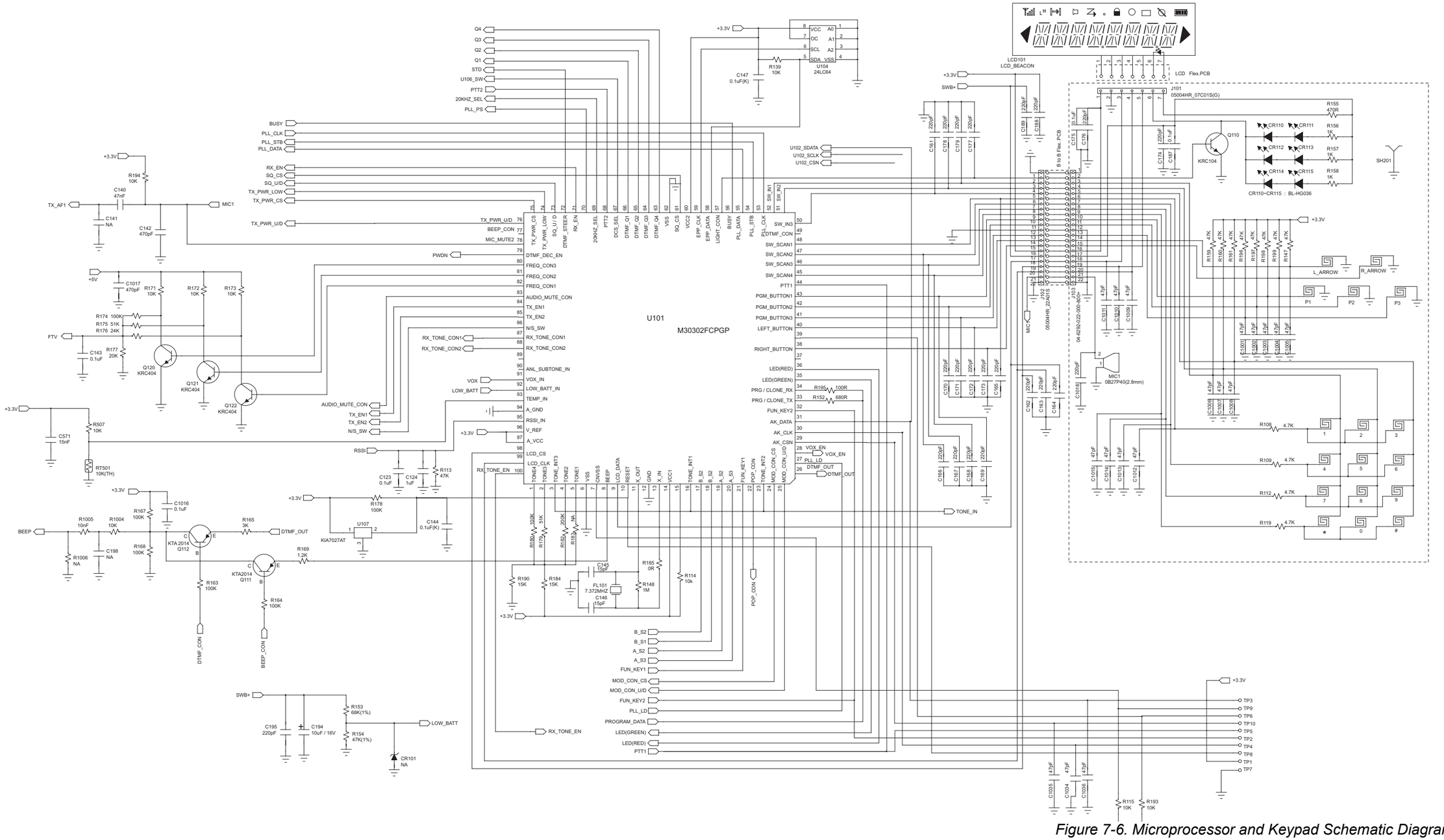


Figure 7-6. Microprocessor and Keypad Schematic Diagram

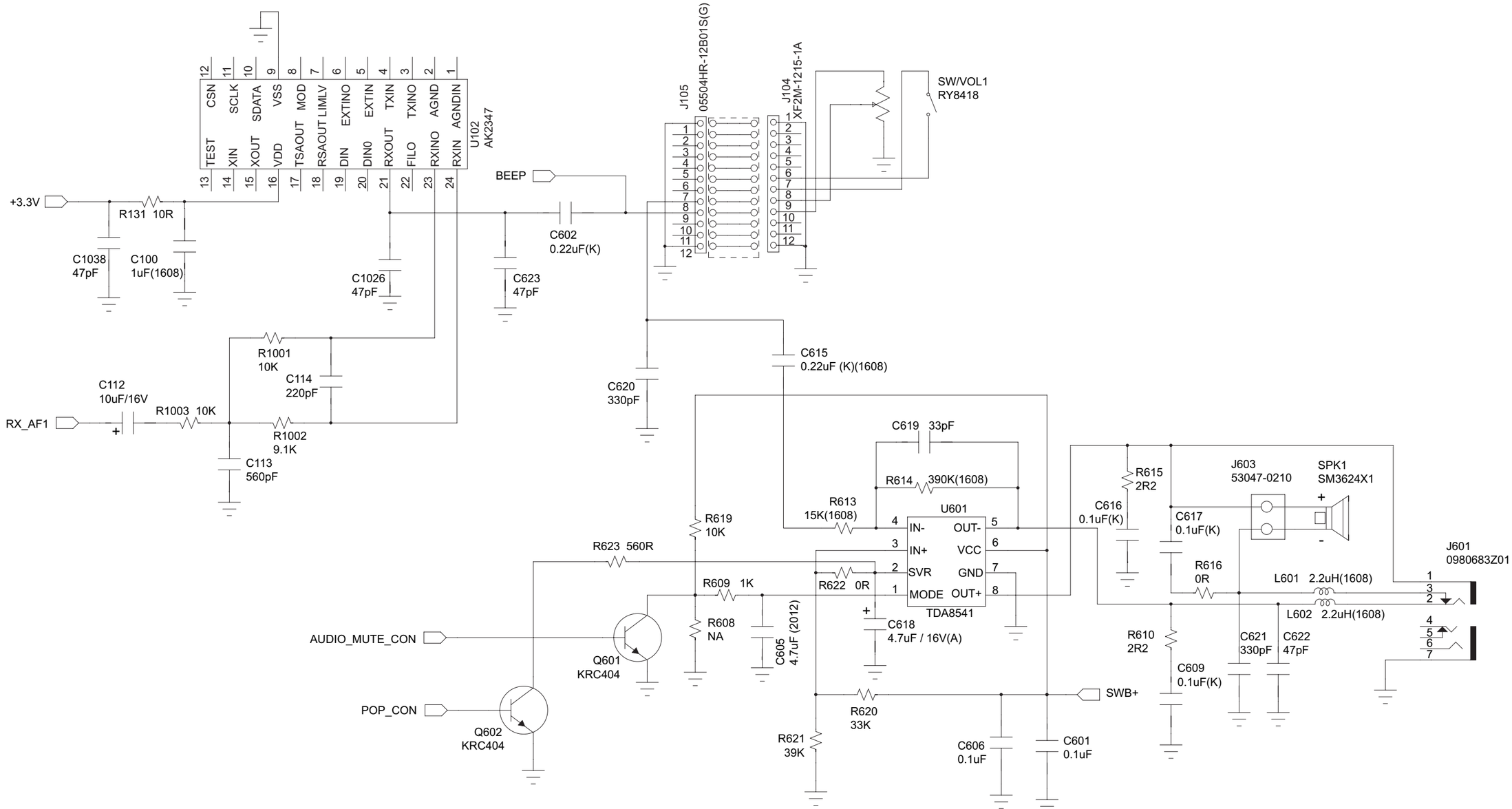


Figure 7-7. Audio Power Amplifier and External Audio Schematic Diagram

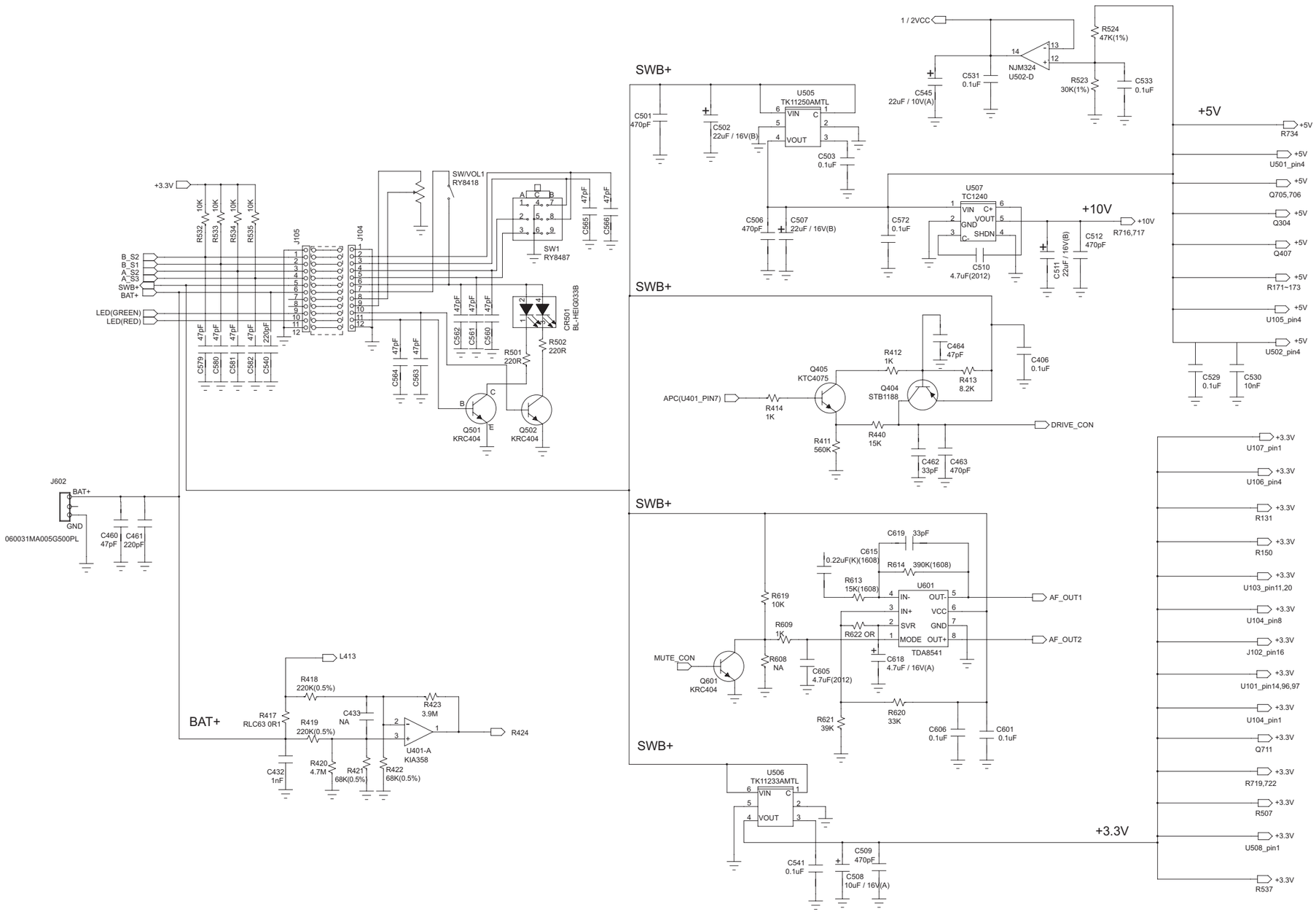


Figure 7-8. Switches and Battery Schematic Diagram

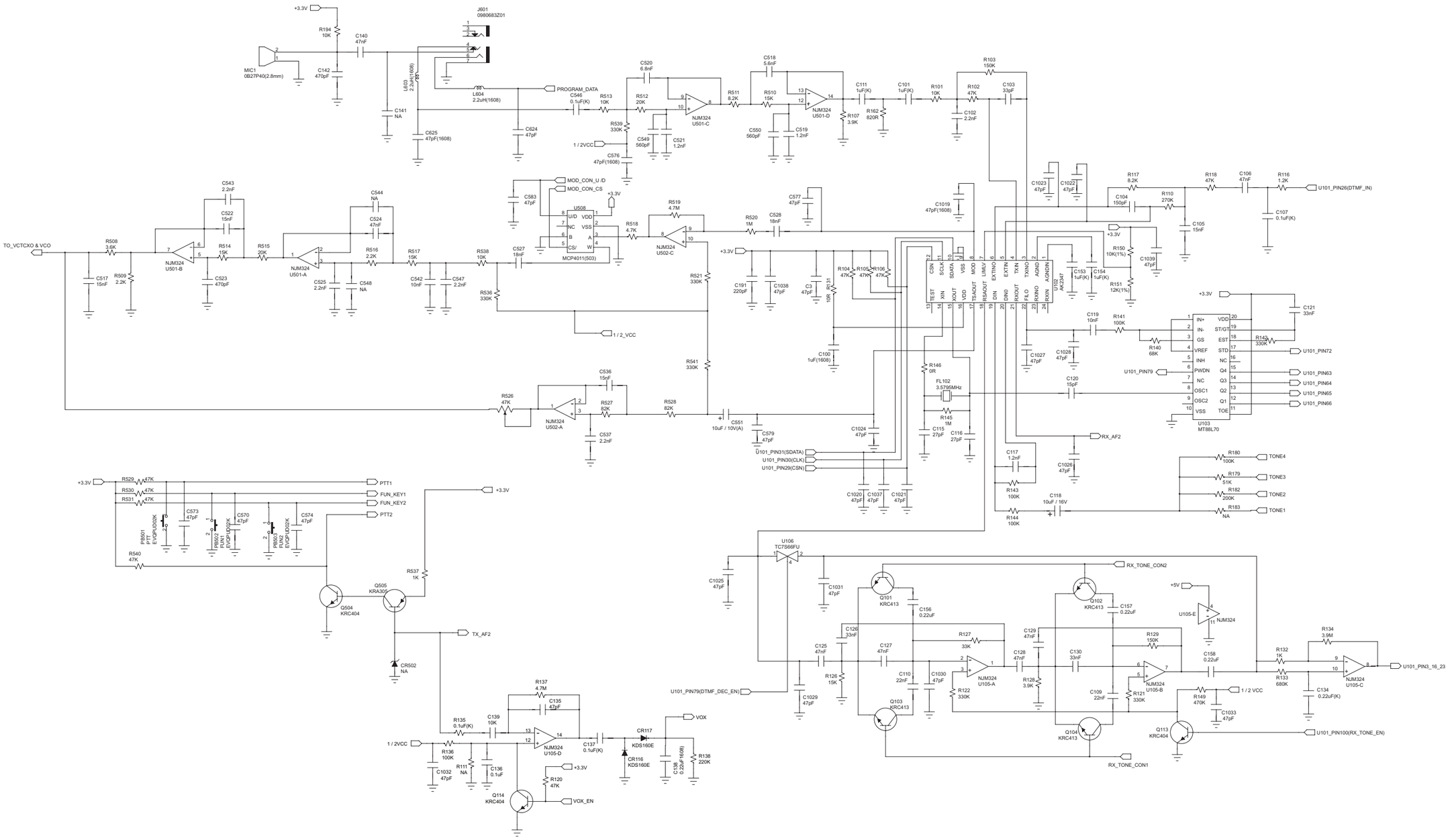


Figure 7-9. Transmitter Audio Filter and Sub-tone Schematic Diagram

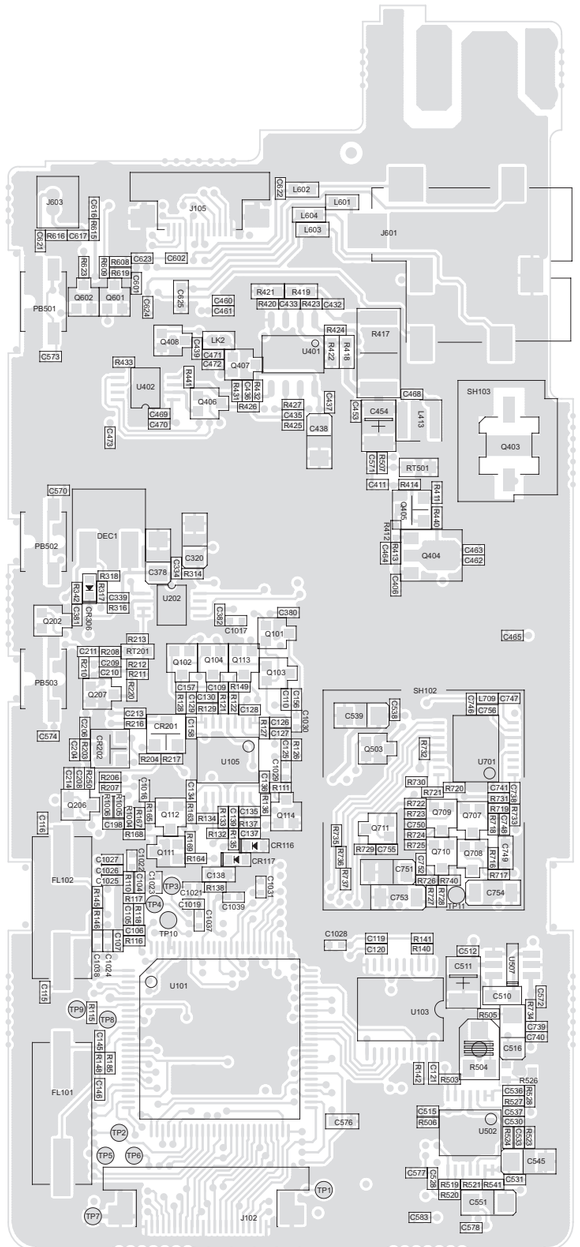
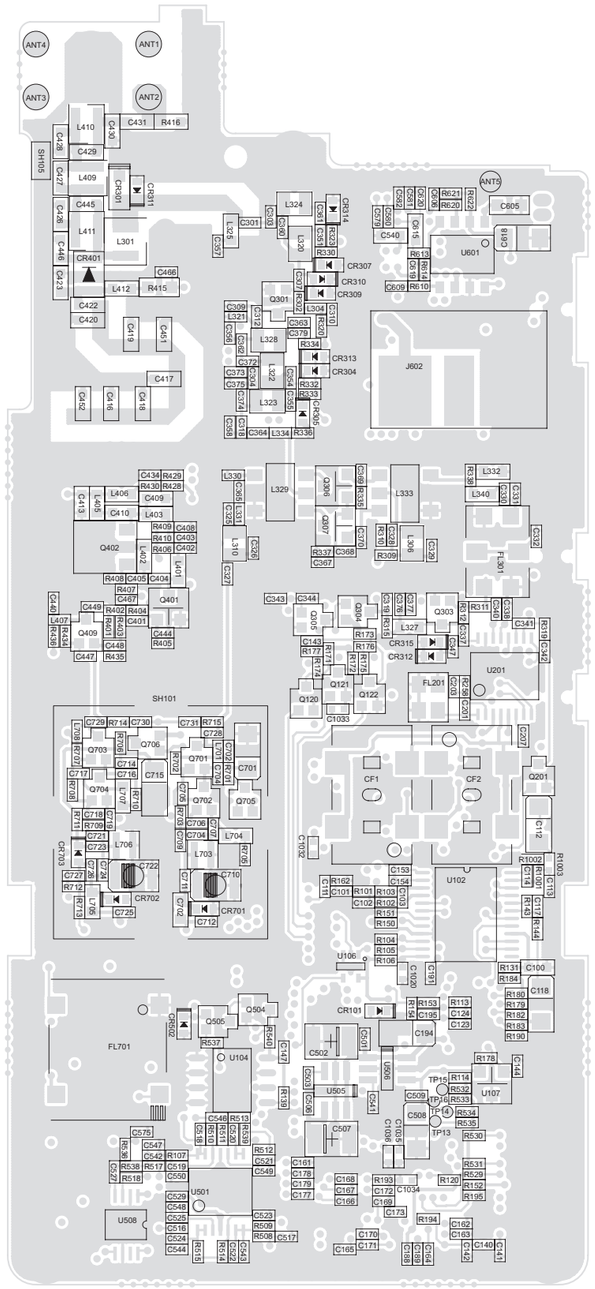


Figure 7-10. UHF2 (435–480 MHz) Mainboard Top Side: PCB No. 8431BEACON200


ANT4
ANT1
ANT3
ANT2
ANT5
L410
C431
R416
C430
C426
C429
SH105
C427
L409
C428
CR311
C445
C436
L411
L301
C446
CR401
C466
C423
L412
R415
C422
C420
C419
C451
C417
C452
C416
C418
L324
CR314
C331
C330
C490
C301
L320
C335
C357
R330
CR307
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CR309
C609
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U601
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C342
R172
C149
R177
R174
R176
CR315
CR312
Q121
Q122
Q120
C1033
U201
FL201
C1001
C1002
C1003
C1004
C1005
C1006
C1007
Q201
C113
C1032
CF1
CF2
C102
C153
C154
U102
R162
C101
R101
R103
C103
C102
R102
R151
R150
R1002
C114
R1001
C115
R149
R148
R104
R105
R106
U106
C104
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C111
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R131
R184
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C126
C123
C194
C502
C501
R153
R113
R154
C195
CR101
Q504
Q505
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R540
C147
FL701
U104
C503
C504
R539
C505
U505
C509
C508
TP15
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TP16
TP13
R114
R532
R533
R534
R535
R530
U107
C144
C178
C179
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C166
R193
R172
C1034
C169
C173
R194
R120
R531
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C141
C575
C547
C542
R107
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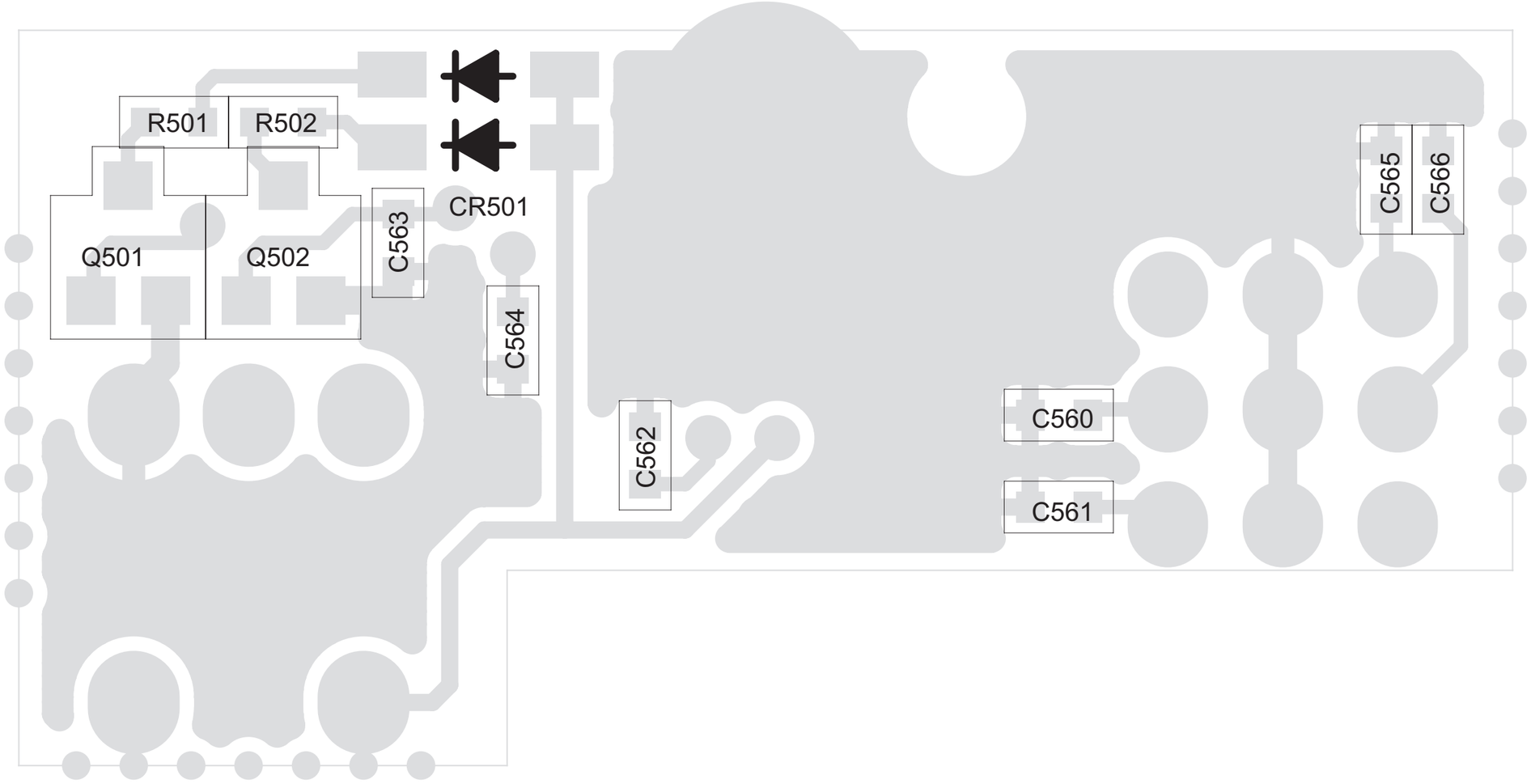


Figure 7-12. UHF2 (435–480 MHz) Sub Circuit Board Top View: PCB No. 8421BEACON100

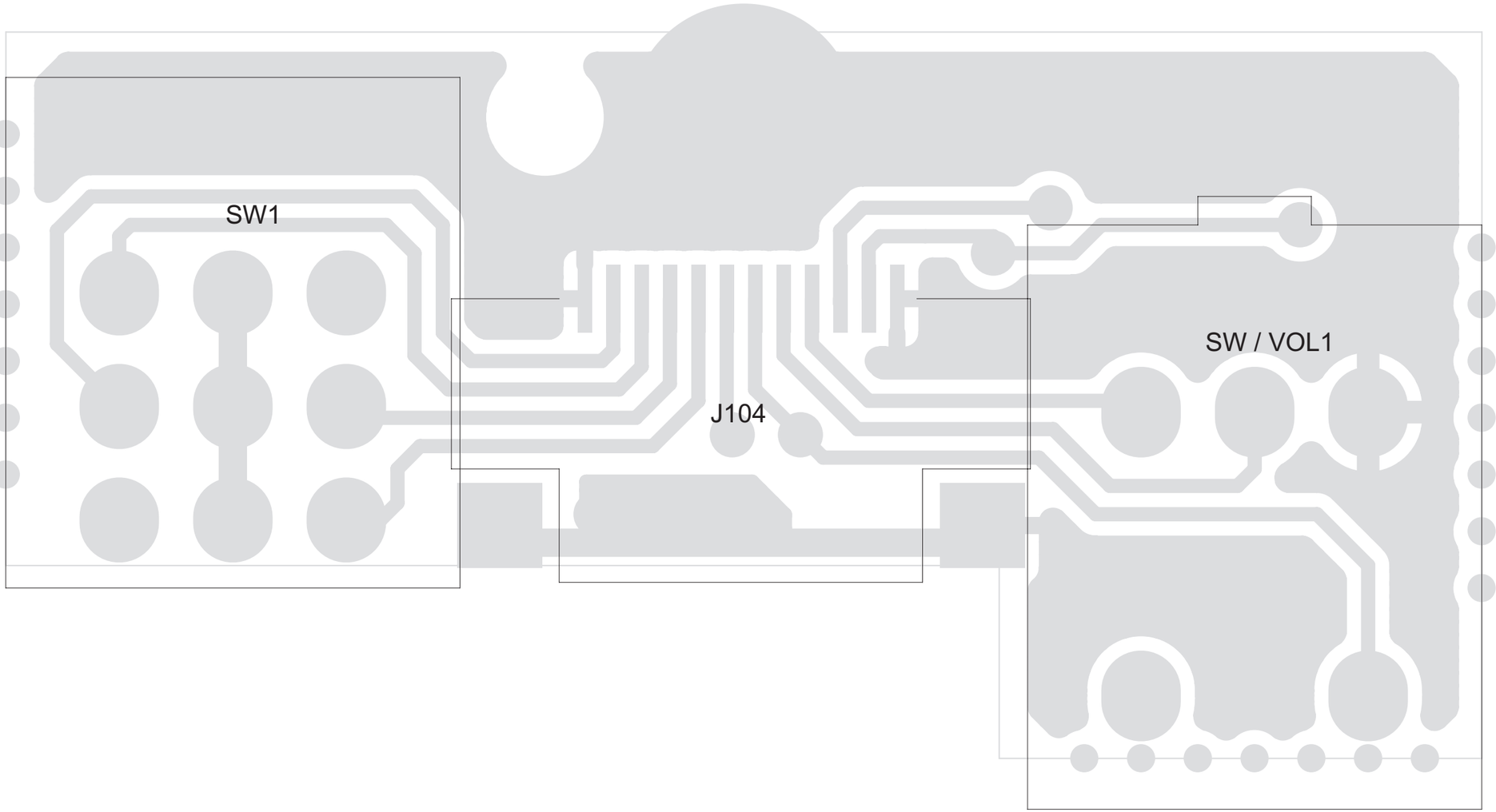


Figure 7-13. UHF2 (435–480 MHz) Sub Circuit Board Bottom View: PCB No. 8421BEACON100

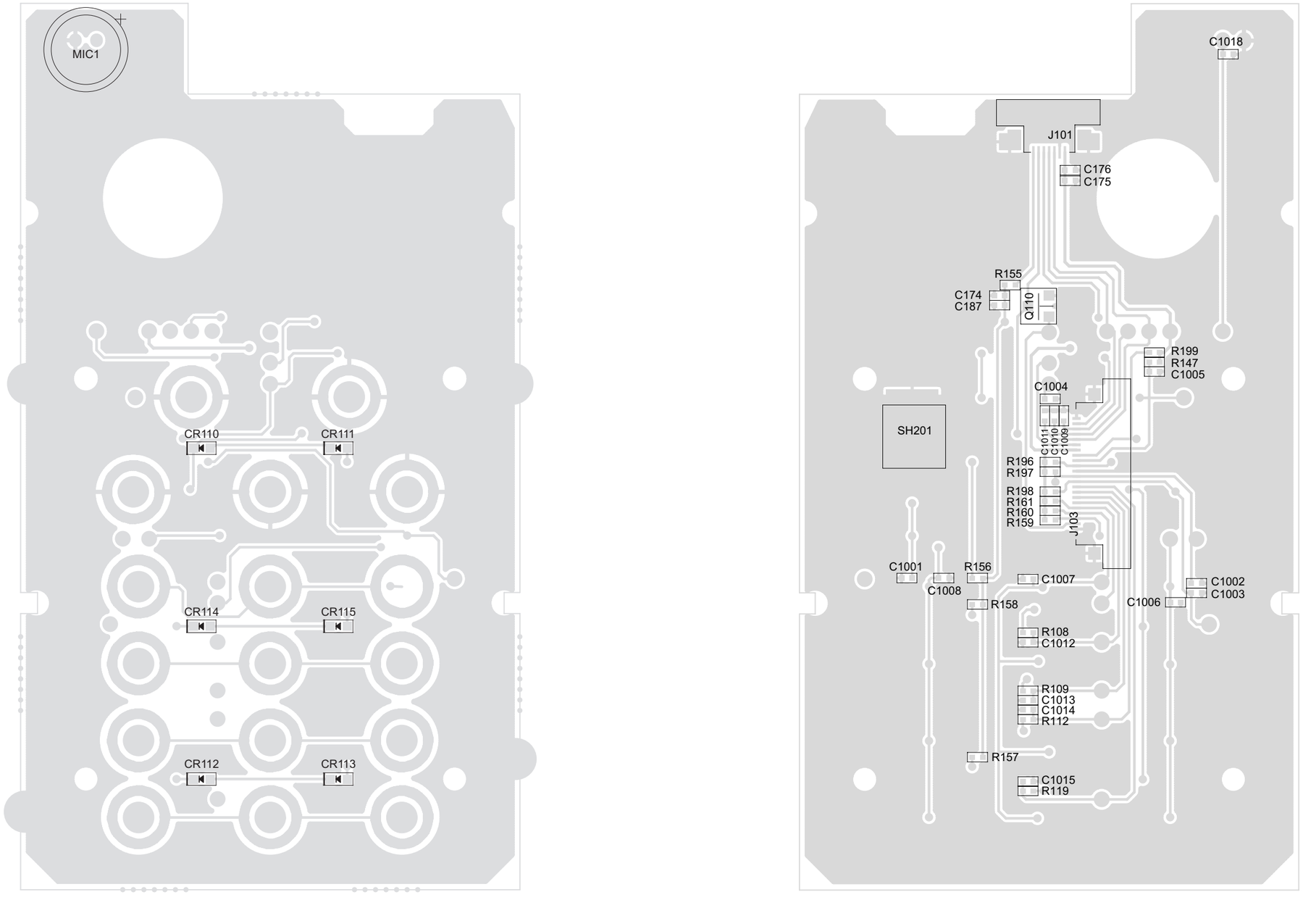


Figure 7-14. UHF2 (435–480 MHz) Keypad Board: PCB No. 8422BEACON100

7.3.1 Parts List

Circuit Ref.	Supplier	Supplier Part No.	Description
C100	TDK	–	Chip Cap, 1608 Z 1µF
C101	TDK	–	Chip Cap, 1005 K 1µF
C102	TDK	–	Chip Cap, 1005 K 2200PF
C103	TDK	–	Chip Cap, 1005 J 33PF
C104	TDK	–	Chip Cap, 1005 J 150PF
C105	TDK	–	Chip Cap, 1005 K 153PF
C106	TDK	–	Chip Cap, 1005 K 473PF
C107	TDK	–	Chip Cap, 1005 K 0.1µF
C109	TDK	–	Chip Cap, 1005 K 223PF
C110	TDK	–	Chip Cap, 1005 K 223PF
C111	TDK	–	Chip Cap, 1005 K 1µF
C112	HITACH	–	Chip Tantal, 10uF–M/ 16V(A)
C113	TDK	–	Chip Cap, 1005 K 560PF
C114	TDK	–	Chip Cap, 1005 J 220PF
C115	TDK	–	Chip Cap, 1005 J 27PF
C116	TDK	–	Chip Cap, 1005 J 27PF
C117	TDK	–	Chip Cap, 1005 K 122PF
C118	HITACH	–	Chip Tantal, 10uF–M/ 16V(A)
C119	TDK	–	Chip Cap, 1005 K 10nF
C120	TDK	–	Chip Cap, 1005 J 15PF
C121	TDK	–	Chip Cap, 1005 K 333PF
C123	TDK	–	Chip Cap, 1005 Z 0.1µF
C124	TDK	–	Chip Cap, 1005 K 1000PF
C125	TDK	–	Chip Cap, 1005 K 473PF
C126	TDK	–	Chip Cap, 1005 K 333PF
C127	TDK	–	Chip Cap, 1005 K 473PF
C128	TDK	–	Chip Cap, 1005 K 473PF
C129	TDK	–	Chip Cap, 1005 K 473PF
C130	TDK	–	Chip Cap,1005 K 333PF
C134	TDK	–	Chip Cap, 1005 K 0.22µF
C135	TDK	–	Chip Cap, 1005 J 47PF
C136	TDK	–	Chip Cap, 1005 Z 0.1µF
C137	TDK	–	Chip Cap, 1005 K 0.1µF
C138	TDK	–	Chip Cap, 1608 K 0.22µF
C139	KAMAYA	–	Chip Res, 1005 J 10KΩ
C140	TDK	–	Chip Cap, 1005 K 473PF
C142	TDK	–	Chip Cap, 1005 K 470PF
C143	TDK	–	Chip Cap, 1005 Z 0.1µF
C144	TDK	–	Chip Cap, 1005 K 0.1µF
C145	TDK	–	Chip Cap, 1005 J 15PF
C146	TDK	–	Chip Cap, 1005 J 15PF
C147	TDK	–	Chip Cap, 1005 K 0.1µF
C153	TDK	–	Chip Cap, 1005 K 1µF
C154	TDK	–	Chip Cap, 1005 K 1µF
C156	TDK	–	Chip Cap, 1005 K 0.22µF
C157	TDK	–	Chip Cap, 1005 K 0.22µF
C158	TDK	–	Chip Cap, 1005 K 0.22µF
C161	TDK	–	Chip Cap, 1005 J 220PF
C162	TDK	–	Chip Cap, 1005 J 220PF
C163	TDK	–	Chip Cap, 1005 J 220PF
C164	TDK	–	Chip Cap, 1005 J 220PF
C165	TDK	–	Chip Cap, 1005 J 220PF
C166	TDK	–	Chip Cap, 1005 J 220PF
C167	TDK	–	Chip Cap, 1005 J 220PF
C168	TDK	–	Chip Cap, 1005 J 220PF
C169	TDK	–	Chip Cap, 1005 J 220PF
C170	TDK	–	Chip Cap, 1005 J 220PF
C171	TDK	–	Chip Cap, 1005 J 220PF
C172	TDK	–	Chip Cap, 1005 J 220PF
C173	TDK	–	Chip Cap, 1005 J 220PF
C174	TDK	–	Chip Cap, 1005 J 220PF
C175	TDK	–	Chip Cap, 1005 Z 0.1µF
C176	TDK	–	Chip Cap, 1005 J 220PF
C177	TDK	–	Chip Cap, 1005 J 220PF
C178	TDK	–	Chip Cap, 1005 J 220PF
C179	TDK	–	Chip Cap, 1005 J 220PF
C187	TDK	–	Chip Cap, 1005 Z 0.1µF
C188	TDK	–	Chip Cap, 1005 J 220PF
C189	TDK	–	Chip Cap, 1005 J 220PF
C191	TDK	–	Chip Cap, 1005 J 220PF
C194	HITACH	–	Chip Tantal, 10uF–M/ 16V(A)
C195	TDK	–	Chip Cap, 1005 J 220PF
C201	TDK	–	Chip Cap, 1005 J 47PF
C203	TDK	–	Chip Cap, 1005 J 120PF
C204	TDK	–	Chip Cap, 1005 Z 0.1µF
C206	TDK	–	Chip Cap, 1005 K 0.1µF
C207	TDK	–	Chip Cap, 1005 K 0.1µF
C208	TDK	–	Chip Cap, 1005 Z 0.1µF
C209	TDK	–	Chip Cap, 1005 J 330PF
C210	TDK	–	Chip Cap, 1005 J 330PF
C211	TDK	–	Chip Cap, 1005 K 0.1µF
C213	TDK	–	Chip Cap, 1005 K 0.1µF
C214	TDK	–	Chip Cap, 1005 Z 0.1µF
C301	TDK	–	Chip Cap, 1005 C 5PF
C303	TDK	–	Chip Cap, 1005 C 3PF
C304	KAMAYA	–	Chip Res, 1005 J 0Ω
C307	TDK	–	Chip Cap, 1005 J 18PF
C309	TDK	–	Chip Cap, 1005 C 3PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C310	TDK	–	Chip Cap, 1005 Z 0.1µF
C312	TDK	–	Chip Cap, 1005 J 15PF
C318	TDK	–	Chip Cap, 1005 J 15PF
C319	TDK	–	Chip Cap, 1005 K 10nF
C320	HITACH	–	Chip Tantal, 10uF–M/ 16V(A)
C325	TDK	–	Chip Cap, 1005 J 33PF
C326	TDK	–	Chip Cap, 1005 C 3PF
C327	TDK	–	Chip Cap, 1005 J 12PF
C328	TDK	–	Chip Cap, 1005 C 2PF
C329	TDK	–	Chip Cap, 1005 K 10nF
C330	TDK	–	Chip Cap, 1005 J 39PF
C331	TDK	–	Chip Cap, 1005 D 9PF
C332	TDK	–	Chip Cap, 1005 D 10PF
C334	TDK	–	Chip Cap, 1005 K 1000PF
C337	TDK	–	Chip Cap, 1005 K 10nF
C338	TDK	–	Chip Cap, 1005 K 473PF
C339	TDK	–	Chip Cap, 1005 K 0.1µF
C340	TDK	–	Chip Cap, 1005 K 0.1µF
C341	TDK	–	Chip Cap, 1005 J 56PF
C342	TDK	–	Chip Cap, 1005 K 0.1µF
C343	TDK	–	Chip Cap, 1005 Z 0.1µF
C344	TDK	–	Chip Cap, 1005 K 470PF
C347	TDK	–	Chip Cap, 1005 Z 0.1µF
C351	TDK	–	Chip Cap, 1005 D 10PF
C354	TDK	–	Chip Cap, 1005 D 10PF
C355	TDK	–	Chip Cap, 1005 J 15PF
C357	TDK	–	Chip Cap, 1005 J 56PF
C358	TDK	–	Chip Cap, 1005 J 15PF
C360	TDK	–	Chip Cap, 1005 C 4PF
C361	TDK	–	Chip Cap, 1005 J 22PF
C362	TDK	–	Chip Cap, 1005 D 10PF
C364	TDK	–	Chip Cap, 1005 J 33PF
C365	TDK	–	Chip Cap, 1005 J 27PF
C367	TDK	–	Chip Cap, 1005 J 220PF
C368	TDK	–	Chip Cap, 1005 K 10nF
C372	TDK	–	Chip Cap, 1005 J 33PF
C373	TDK	–	Chip Cap, 1005 J 20PF
C374	TDK	–	Chip Cap, 1005 D 10PF
C376	TDK	–	Chip Cap, 1005 Z 0.1µF
C378	HITACH	–	Chip Tantal, 10uF–M/ 16V(A)
C379	TDK	–	Chip Cap, 1005 J 20PF
C380	TDK	–	Chip Cap, 1005 J 47PF
C382	TDK	–	Chip Cap, 1005 Z 0.1µF
C401	TDK	–	Chip Cap, 1005 C 3PF
C402	TDK	–	Chip Cap, 1005 K 10nF
C403	TDK	–	Chip Cap, 1005 K 470PF
C404	TDK	–	Chip Cap, 1005 J 56PF
C405	TDK	–	Chip Cap, 1005 J 56PF
C406	TDK	–	Chip Cap, 1005 Z 0.1µF
C408	TDK	–	Chip Cap, 1005 K 10nF
C410	TDK	–	Chip Cap, 1608 J 27PF
C413	TDK	–	Chip Cap, 1608 J 27PF
C416	TDK	–	Chip Cap, 1608 D 7PF
C417	TDK	–	Chip Cap, 1608 J 12PF
C418	TDK	–	Chip Cap, 1608 J 15PF
C420	TDK	–	Chip Cap, 1608 D 10PF
C422	TDK	–	Chip Cap, 1608 J 12PF
C426	TDK	–	Chip Cap, 1608 C 6PF
C427	TDK	–	Chip Cap, 1608 C 4PF
C428	TDK	–	Chip Cap, 1608 C 6PF
C429	TDK	–	Chip Cap, 1608 C 5PF
C431	TDK	–	Chip Cap, 1608 K 1000PF
C432	TDK	–	Chip Cap, 1005 K 1000PF
C434	TDK	–	Chip Cap, 1005 K 470PF
C435	TDK	–	Chip Cap, 1005 K 473PF
C436	TDK	–	Chip Cap, 1005 Z 0.1µF
C437	TDK	–	Chip Cap, 1005 Z 0.1µF
C439	TDK	–	Chip Cap, 1005 K 1000PF
C440	TDK	–	Chip Cap, 1005 K 470PF
C445	TDK	–	Chip Cap, 1608 C 3PF
C446	TDK	–	Chip Cap, 1608 C 4PF
C447	TDK	–	Chip Cap, 1005 C 3PF
C448	TDK	–	Chip Cap, 1005 K 10nF
C449	TDK	–	Chip Cap, 1005 C 3PF
C451	TDK	–	Chip Cap, 1608 C 3PF
C452	TDK	–	Chip Cap, 1608 J 33PF
C453	TDK	–	Chip Cap, 1005 K 470PF
C454	HITACH	–	Chip Tantal, 22uF–M/ 16V(B)
C460	TDK	–	Chip Cap, 1005 J 47PF
C461	TDK	–	Chip Cap, 1005 J 220PF
C462	TDK	–	Chip Cap, 1005 J 33PF
C463	TDK	–	Chip Cap, 1005 K 470PF
C464	TDK	–	Chip Cap, 1005 J 47PF
C465	TDK	–	Chip Cap, 1005 K 470PF
C466	TDK	–	Chip Cap, 1005 K 470PF
C467	TDK	–	Chip Cap, 1005 K 470PF
C468	TDK	–	Chip Cap, 1005 C 0.5PF
C469	TDK	–	Chip Cap, 1005 Z 0.1µF
C470	TDK	–	Chip Cap, 1005 J 47PF
C471	TDK	–	Chip Cap, 1005 Z 0.1µF

Circuit Ref.	Supplier	Supplier Part No.	Description
C472	TDK	–	Chip Cap, 1005 K 470PF
C473	TDK	–	Chip Cap, 1005 J 47PF
C501	TDK	–	Chip Cap, 1005 K 470PF
C502	HITACH	–	Chip Tantal, 22uF–M/ 16V(B)
C503	TDK	–	Chip Cap, 1005 Z 0.1µF
C506	TDK	–	Chip Cap, 1005 K 470PF
C507	HITACH	–	Chip Tantal, 22uF–M/ 16V(B)
C508	HITACH	–	Chip Tantal, 10uF–M/ 16V(A)
C509	TDK	–	Chip Cap, 1005 K 470PF
C510	TDK	–	Chip Cap, 2012 Z 475PF
C511	HITACH	–	Chip Tantal, 22uF–M/ 16V(B)
C512	TDK	–	Chip Cap, 1005 K 470PF
C515	TDK	–	Chip Cap, 1005 Z 0.1µF
C516	HITACH	–	Chip Tantal, 10uF–M/ 16V(A)
C517	TDK	–	Chip Cap, 1005 K 153PF
C518	TDK	–	Chip Cap, 1005 K 562PF
C519	TDK	–	Chip Cap, 1005 K 122PF
C520	TDK	–	Chip Cap, 1005 K 682PF
C521	TDK	–	Chip Cap, 1005 K 122PF
C522	TDK	–	Chip Cap, 1005 K 153PF
C523	TDK	–	Chip Cap, 1005 K 470PF
C524	TDK	–	Chip Cap, 1005 K 473PF
C525	TDK	–	Chip Cap, 1005 K 2200PF
C527	TDK	–	Chip Cap, 1005 K 183PF
C528	TDK	–	Chip Cap, 1005 K 183PF
C529	TDK	–	Chip Cap, 1005 Z 0.1µF
C530	TDK	–	Chip Cap, 1005 K 10nF

Circuit Ref.	Supplier	Supplier Part No.	Description
C531	TDK	–	Chip Cap, 1005 Z 0.1µF
C533	TDK	–	Chip Cap, 1005 Z 0.1µF
C536	TDK	–	Chip Cap, 1005 K 153PF
C537	TDK	–	Chip Cap, 1005 K 2200PF
C538	TDK	–	Chip Cap, 1005 K 10nF
C539	HITACH	–	Chip Tantal, 10uF–M/ 16V(A)
C540	TDK	–	Chip Cap, 1608 J 220PF
C541	TDK	–	Chip Cap, 1005 Z 0.1µF
C542	TDK	–	Chip Cap, 1005 K 10nF
C543	TDK	–	Chip Cap, 1005 K 2200PF
C545	HITACH	–	Chip Tantal, 22uF–M/ 10V(A)
C546	TDK	–	Chip Cap, 1005 K 0.1µF
C547	TDK	–	Chip Cap, 1005 K 2200PF
C549	TDK	–	Chip Cap, 1005 K 560PF
C550	TDK	–	Chip Cap, 1005 K 560PF
C551	HITACH	–	Chip Tantal, 10uF–M/ 10V(A)
C560	TDK	–	Chip Cap, 1005 J 47PF
C561	TDK	–	Chip Cap, 1005 J 47PF
C562	TDK	–	Chip Cap, 1005 J 47PF
C563	TDK	–	Chip Cap, 1005 J 47PF
C564	TDK	–	Chip Cap, 1005 J 47PF
C565	TDK	–	Chip Cap, 1005 J 47PF
C566	TDK	–	Chip Cap, 1005 J 47PF
C570	TDK	–	Chip Cap, 1005 J 47PF
C571	TDK	–	Chip Cap, 1005 K 153PF
C572	TDK	–	Chip Cap, 1005 Z 0.1µF
C573	TDK	–	Chip Cap, 1005 J 47PF
C574	TDK	–	Chip Cap, 1005 J 47PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C575	TDK	–	Chip Cap, 1005 J 47PF
C576	TDK	–	Chip Cap, 1608 J 47PF
C577	TDK	–	Chip Cap, 1005 J 47PF
C578	TDK	–	Chip Cap, 1005 J 47PF
C579	TDK	–	Chip Cap, 1005 J 47PF
C580	TDK	–	Chip Cap, 1005 J 47PF
C581	TDK	–	Chip Cap, 1005 J 47PF
C582	TDK	–	Chip Cap, 1005 J 47PF
C583	TDK	–	Chip Cap, 1005 J 47PF
C601	TDK	–	Chip Cap, 1005 Z 0.1µF
C602	TDK	–	Chip Cap, 1005 K 0.22µF
C605	TDK	–	Chip Cap, 2012 Z 475PF
C606	TDK	–	Chip Cap, 1005 Z 0.1µF
C609	TDK	–	Chip Cap, 1005 K 0.1µF
C615	TDK	–	Chip Cap, 1608 K 0.22µF
C616	TDK	–	Chip Cap, 1005 K 0.1µF
C617	TDK	–	Chip Cap, 1005 K 0.1µF
C618	HITACH	–	Chip Tantal, 4.7uF–M/ 16V(A)
C619	TDK	–	Chip Cap, 1005 J 33PF
C620	TDK	–	Chip Cap, 1005 J 330PF
C621	TDK	–	Chip Cap, 1005 J 330PF
C622	TDK	–	Chip Cap, 1005 J 47PF
C623	TDK	–	Chip Cap, 1005 J 47PF
C624	TDK	–	Chip Cap, 1005 J 47PF
C625	TDK	–	Chip Cap, 1608 J 47PF
C701	HITACH	–	Chip Tantal, 22uF–M/ 10V(A)
C702	TDK	–	Chip Cap, 1005 K 1000PF
C704	TDK	–	Chip Cap, 1005 K 1000PF
C705	TDK	–	Chip Cap, 1005 C 2PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C706	TDK	–	Chip Cap, 1005 C 3PF
C707	TDK	–	Chip Cap, 1005 D 9PF
C709	TDK	–	Chip Cap, 1005 C 4PF
C710	MURATA	–	Chip Trimmer Cap, 2PIE 6PF
C711	MURATA	–	Chip Cap, 1005 J 13PF 10V
C712	TDK	–	Chip Cap, 1005 K 470PF
C714	TDK	–	Chip Cap, 1005 K 1000PF
C715	HITACH	–	Chip Tantal, 22uF–M/ 10V(A)
C716	TDK	–	Chip Cap, 1005 K 470PF
C717	TDK	–	Chip Cap, 1005 C 3PF
C718	TDK	–	Chip Cap, 1005 C 4PF
C719	TDK	–	Chip Cap, 1005 D 7PF
C721	TDK	–	Chip Cap, 1005 C 3PF
C722	MURATA	–	Chip Trimmer Cap, 2PIE 6PF
C723	TDK	–	Chip Cap, 1005 C 0.5PF
C724	MURATA	–	Chip Cap, 1005 J 11PF 10V
C725	TDK	–	Chip Cap, 1005 K 470PF
C726	TDK	–	Chip Cap, 1005 C 0.5PF
C727	TDK	–	Chip Cap, 1005 C 2PF
C728	TDK	–	Chip Cap, 1005 C 4PF
C729	TDK	–	Chip Cap, 1005 D 6PF
C730	TDK	–	Chip Cap, 1005 C 2PF
C731	TDK	–	Chip Cap, 1005 C 2PF
C738	TDK	–	Chip Cap, 1005 D 7PF
C739	TDK	–	Chip Cap, 1005 K 1000PF
C740	TDK	–	Chip Cap, 1005 Z 0.1µF
C741	TDK	–	Chip Cap, 1005 Z 0.1µF

Circuit Ref.	Supplier	Supplier Part No.	Description
C746	TDK	–	Chip Cap, 1005 D 10PF
C747	TDK	–	Chip Cap, 1005 D 10PF
C748	TDK	–	Chip Cap, 1005 Z 0.1µF
C749	TDK	–	Chip Cap, 1608 Z 1µF
C750	TDK	–	Chip Cap, 1005 Z 0.1µF
C751	HITACH	–	Chip Tantal, 1uF–M/ 35V(A)
C752	TDK	–	Chip Cap, 1005 K 0.1µF
C753	PANASINIC	–	Film Chip Cap, 3216 J 473PF
C754	PANASINIC	–	Film Chip Cap, 3216 J 473PF
C755	TDK	–	Chip Cap, 1005 K 0.1µF
C756	TDK	–	Chip Cap, 1005 K 1000PF
C1001	TDK	–	Chip Cap, 1005 J 47PF
C1002	TDK	–	Chip Cap, 1005 J 47PF
C1003	TDK	–	Chip Cap, 1005 J 47PF
C1004	TDK	–	Chip Cap, 1005 J 47PF
C1005	TDK	–	Chip Cap, 1005 J 47PF
C1006	TDK	–	Chip Cap, 1005 J 47PF
C1007	TDK	–	Chip Cap, 1005 J 47PF
C1008	TDK	–	Chip Cap, 1005 J 47PF
C1009	TDK	–	Chip Cap, 1005 J 47PF
C1010	TDK	–	Chip Cap, 1005 J 47PF
C1011	TDK	–	Chip Cap, 1005 J 47PF
C1012	TDK	–	Chip Cap, 1005 J 47PF
C1013	TDK	–	Chip Cap, 1005 J 47PF
C1014	TDK	–	Chip Cap, 1005 J 47PF
C1015	TDK	–	Chip Cap, 1005 J 47PF
C1016	TDK	–	Chip Cap, 1005 Z 0.1µF
C1017	TDK	–	Chip Cap, 1005 K 470PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C1018	TDK	–	Chip Cap, 1005 J 220PF
C1019	TDK	–	Chip Cap, 1005 J 47PF
C1020	TDK	–	Chip Cap, 1005 J 47PF
C1021	TDK	–	Chip Cap, 1005 J 47PF
C1022	TDK	–	Chip Cap, 1005 J 47PF
C1023	TDK	–	Chip Cap, 1005 J 47PF
C1024	TDK	–	Chip Cap, 1005 J 47PF
C1025	TDK	–	Chip Cap, 1005 J 47PF
C1026	TDK	–	Chip Cap, 1005 J 47PF
C1027	TDK	–	Chip Cap, 1005 J 47PF
C1028	TDK	–	Chip Cap, 1005 J 47PF
C1029	TDK	–	Chip Cap, 1005 J 47PF
C1030	TDK	–	Chip Cap, 1005 J 47PF
C1031	TDK	–	Chip Cap, 1005 J 47PF
C1032	TDK	–	Chip Cap, 1005 J 47PF
C1033	TDK	–	Chip Cap, 1005 J 47PF
C1034	TDK	–	Chip Cap, 1005 J 47PF
C1035	TDK	–	Chip Cap, 1005 J 47PF
C1036	TDK	–	Chip Cap, 1005 J 47PF
C1037	TDK	–	Chip Cap, 1005 J 47PF
C1038	TDK	–	Chip Cap, 1005 J 47PF
C1039	TDK	–	Chip Cap, 1005 J 47PF
CF1	BGTech	8286045500120	TOKO, Ceramic Filter, ELFY455F
CF2	BGTech	8286045500220	TOKO, Ceramic Filter, ELFY455H
CR110	BRIGHT LED	–	LED DIODE, BL-HG036D-TR
CR111	BRIGHT LED	–	LED DIODE, BL-HG036D-TR
CR112[2]	BRIGHT LED	–	LED DIODE, BL-HG036D-TR

Circuit Ref.	Supplier	Supplier Part No.	Description
CR113[2]	BRIGHT LED	–	LED DIODE, BL-HG036D-TR
CR114[2]	BRIGHT LED	–	LED DIODE, BL-HG036D-TR
CR115[2]	BRIGHT LED	–	LED DIODE, BL-HG036D-TR
CR116	KEC	–	SWITCH DIODE, KDS–160E (ESM)
CR117	KEC	–	SWITCH DIODE, KDS–160E (ESM)
CR201	KEC	–	SWITCH DIODE, KDS 181
CR202	KEC	–	SWITCH DIODE, KDS 181
CR301	KEC	–	SWITCH DIODE, KDS–114
CR304	KEC	–	VARIABLE DIODE, KDV–154E (ESM)
CR305	KEC	–	VARIABLE DIODE, KDV–154E (ESM)
CR306	KEC	–	SWITCH DIODE, KDS–160E (ESM)
CR307	KEC	–	VARIABLE DIODE, KDV–154E (ESM)
CR309	KEC	–	SWITCH DIODE, KDS–114E (ESM)
CR310	KEC	–	SWITCH DIODE, KDS–114E (ESM)
CR312	KEC	–	SWITCH DIODE, KDS–160E (ESM)
CR313	KEC	–	VARIABLE DIODE, KDV–154E (ESM)
CR314	KEC	–	VARIABLE DIODE, KDV–154E (ESM)
CR315	KEC	–	SWITCH DIODE, KDS–160E (ESM)
CR401	M/A COM	–	PIN DIODE, MA4P7001F–1072T

Circuit Ref.	Supplier	Supplier Part No.	Description
CR501	BRIGHT LED	–	LED DIODE, BL-HEIG033B-TR
CR701	KEC	–	VARIABLE DIODE, KDV–154E (ESM)
CR702	KEC	–	VARIABLE DIODE, KDV–154E (ESM)
CR703	KEC	–	VARIABLE DIODE, KDV–154E (ESM)
DEC1	BGTech	8287455C24010	CQ, Descriminator, JTBC455C24 (LCP)
FL101	BGTech	82827R3728M00	SHINSUNG, Crystal, 7.3728MHz (H: 2.8mm)
FL102	BGTech	82823R5795M00	SHINSUNG, Crystal, 3.5795MHz (H: 2.8mm)
FL201	BGTech	828244R645M00	SHINSUNG, Crystal, 44.645MHz (SMD)
FL301	BGTech	828645R100220	SHINSUNG, Crystal Filter, MCF 45.15S12.B (8.5 kHz)
FL701	BGTech	8289012R80010	SHINSUNG, VCTCXO, 12.8 MHZ
F–CABLE 1	BGTech	8560228005000	SNAGGWA, BEACON FLAT CABLE, FF12–22N080XXA
F–CABLE 2	BGTech	8560124005000	SNAGGWA, , BEACON FLAT CABLE, FF12–12N040XXA
J101	BGTech	851607C01S110	YUNHO, FPC CONNECTOR, 05004HR-07C01S(G)
J102	BGTech	851622A01S110	YUNHO, FPC CONNECTOR, 05004HR–22A01S
J103	BGTech	8516220005020	KYOCERA, FPC CONNECTOR, 04-6292-022-000-800+
J104	BGTech	851612151A110	OMIRON, FPC CONNECTOR, XF2M-1215-1A

Circuit Ref.	Supplier	Supplier Part No.	Description
J105	BGTech	851612A01S110	YUNHO, FPC CONNECTOR, 05004HR–12B01S(G)
J601	BGTech	8500031009800	CHI CHENG, SPK MIC JACK, 0980683Z01–D
J602	BGTech	85100G500PL00	SUYIN, BATTERY CONNECTOR, 060031MA005G500PL
J603	BGTech	8510530470210	MOLEX, CONNECTOR, 53047–0210
L301	DEARIM	–	Coil Air, 0.45–1.4–5TL
L304	TAIYOYUDEN	–	Chip Ind, 1005 J 39N
L306	DELTA	–	Chip Ind, 2012 820NH (Tolerance: 5%)
L310	DELTA	–	Chip Ind, 2012 18NH
L320	DELTA	–	Chip Ind, 2012 22nH
L322	DELTA	–	Chip Ind, 2012 18NH
L323	DELTA	–	Chip Ind, 2012 18NH
L324	DELTA	–	Chip Ind, 2012 22nH
L325	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L327	TAIYOYUDEN	–	Chip Ind, 1608 K 820NH
L328	DELTA	–	Chip Ind, 2012 18NH
L329	BGTech	8920PT1667020	TOKO, #617PT–1667
L330	TAIYOYUDEN	–	Chip Ind, 1005 J 33nH
L331	KAMAYA	–	Chip Res, 1005 J 0Ω
L332	TAIYOYUDEN	–	Chip Ind, 1608 K 820NH
L333	BGTech	8920PT1664020	TOKO, #617PT–1664
L334	TAIYOYUDEN	–	Chip Ind, 1005 J 8.2nH
L340	TAIYOYUDEN	–	Chip Ind, 1608 K 820NH
L401	TAIYOYUDEN	–	Chip Ind, 1608 J 27nH
L402	TAIYOYUDEN	–	Chip Ind, 1608 J 22nH
L403	TAIYOYUDEN	–	Chip Ind, 1608 33NJ
L405	TAIYOYUDEN	–	Chip Ind, 1608 J 6.8nH

Circuit Ref.	Supplier	Supplier Part No.	Description
L406	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L407	TAIYOYUDEN	–	Chip Ind, 1005 J 33nH
L409	DEARIM	–	Coil Air, 0.45–1.4–3TL
L410	DEARIM	–	Coil Air, 0.45–1.4–3TL
L411	DEARIM	–	Coil Air, 0.45–1.4–3TL
L412	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L413	DEARIM	–	Coil Air, 0.35–1.6–7TL
L601	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L602	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L603	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L604	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L701	TAIYOYUDEN	–	Chip Ind, 1005 J 27N
L702	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L703	DAERIM	–	Coil Air, 0.3–1.1–3TL
L704	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L705	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L706	DAERIM	–	Coil Air, 0.3–1.0–3TL
L707	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L708	TAIYOYUDEN	–	Chip Ind, 1005 J 27N
L709	TAIYOYUDEN	–	Chip Ind, 1005 J 22N
LCD101	BGTech	86343208A2020	EVERRVIEW,VBS3208A2–7FWLYA,REV4.0
MIC1	BGTech	8420063215000	BSE, C-MIC, 6.0*2.7/2.2KΩ,2V,-44±3dB, Pin type
PB501	BGTech	8466PUD02K020	PANASONIC, Tack Switch, EVQPUD02K
PB502	BGTech	8466PUD02K020	PANASONIC, Tack Switch, EVQPUD02K
PB503	BGTech	8466PUD02K020	PANASONIC, Tack Switch, EVQPUD02K
Q101	KEC	–	KRC 413 BJT NPN Transistor
Q102	KEC	–	KRC 413 BJT NPN Transistor
Q103	KEC	–	KRC 413 BJT NPN Transistor
Q104	KEC	–	KRC 413 BJT NPN Transistor
Q110	NEC	–	2SC4226 BJT NPN Transistor
Q111	KEC	–	KTA 2014 BJT PNP Transistor
Q112	KEC	–	KTA 2014 BJT PNP Transistor
Q113	KEC	–	KRC 404 BJT NPN Transistor
Q114	KEC	–	KRC 404 BJT NPN Transistor
Q120	KEC	–	KRC 404 BJT NPN Transistor
Q121	KEC	–	KRC 404 BJT NPN Transistor
Q122	KEC	–	KRC 404 BJT NPN Transistor
Q201	KEC	–	KRC 404 BJT NPN Transistor
Q206	KEC	–	KRC 404 BJT NPN Transistor
Q207	KEC	–	KRC 404 BJT NPN Transistor
Q301	KEC	–	2SC4226 BJT NPN Transistor
Q303	NEC	–	2SC4226 BJT NPN Transistor
Q304	KEC	–	KRA 305 BJT PNP Transistor
Q305	KEC	–	KRC 404 BJT NPN Transistor
Q306	BGTech	81492SK711020	2SK711 TOSHIBA FET N–Channel Transistor
Q307	BGTech	81492SK711020	2SK711 TOSHIBA FET N–Channel Transistor
Q401	BGTech	8142000951120	PBR 951LT1 PHILIPS BJT NPN Transistor
Q402	BGTech	8149003078021	2SK3078 TOSHIBA FET N–Channel Transistor
Q403	BGTech	8149003476021	2SK3476 TOSHIBA FET N–Channel Transistor
Q404	BGTech	8145001188021	STB 1188 AUK BJT NPN Transistor
Q405	KEC	–	KTC 4075 BJT NPN Transistor
Q406	KEC	–	KRC 404 BJT NPN Transistor
Q407	KEC	–	KRA 305 BJT PNP Transistor
Q408	KEC	–	KRC 404 BJT NPN Transistor
Q409	NEC	–	2SC4226 BJT NPN Transistor
Q501	KEC	–	KRC 404 BJT NPN Transistor
Q502	KEC	–	KRC 404 BJT NPN Transistor
Q503	KEC	–	KRC 404 BJT NPN Transistor
Q504	KEC	–	KRC 404 BJT NPN Transistor
Q505	KEC	–	KRA 305 BJT PNP Transistor
Q601	KEC	–	KRC 404 BJT NPN Transistor
Q602	KEC	–	KRC 404 BJT NPN Transistor
Q701	NEC	–	2SC4226 BJT NPN Transistor
Q702	NEC	–	2SC4226 BJT NPN Transistor

Circuit Ref.	Supplier	Supplier Part No.	Description
Q703	NEC	–	2SC4226 BJT NPN Transistor
Q704	NEC	–	2SC4226 BJT NPN Transistor
Q705	KEC	–	KRA 305 BJT PNP Transistor
Q706	KEC	–	KRA 305 BJT PNP Transistor
Q707	KEC	–	KTC 4075 BJT NPN Transistor
Q708	KEC	–	KTA 2014 BJT PNP Transistor
Q709	KEC	–	KTA 2014 BJT PNP Transistor
Q710	KEC	–	KTC 4075 BJT NPN Transistor
Q711	KEC	–	KRA 304 BJT PNP Transistor
R101	KAMAYA	–	Chip Res, 1005 J 10KΩ
R102	KAMAYA	–	Chip Res, 1005 J 47KΩ
R103	KAMAYA	–	Chip Res, 1005 J 150KΩ
R104	KAMAYA	–	Chip Res, 1005 J 47KΩ
R105	KAMAYA	–	Chip Res, 1005 J 47KΩ
R106	KAMAYA	–	Chip Res, 1005 J 47KΩ
R107	KAMAYA	–	Chip Res, 1005 J 3.9KΩ
R108[2]	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R109[2]	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R110	KAMAYA	–	Chip Res, 1005 J 270KΩ
R112[2]	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R113	KAMAYA	–	Chip Res, 1005 J 47KΩ
R114	KAMAYA	–	Chip Res, 1005 J 10KΩ
R115	KAMAYA	–	Chip Res, 1005 J 10KΩ
R116	KAMAYA	–	Chip Res, 1005 J 1.2KΩ
R117	KAMAYA	–	Chip Res, 1005 J 8.2KΩ
R118	KAMAYA	–	Chip Res, 1005 J 47KΩ
R119[2]	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R120	KAMAYA	–	Chip Res, 1005 J 47KΩ
R121	KAMAYA	–	Chip Res, 1005 J 330KΩ
R122	KAMAYA	–	Chip Res, 1005 J 330KΩ
R126	KAMAYA	–	Chip Res, 1005 J 15KΩ
R127	KAMAYA	–	Chip Res, 1005 J 33KΩ
R128	KAMAYA	–	Chip Res, 1005 J 3.9KΩ
R129	KAMAYA	–	Chip Res, 1005 J 150KΩ
R131	KAMAYA	–	Chip Res, 1005 J 10Ω
R132	KAMAYA	–	Chip Res, 1005 J 1KΩ
R133	KAMAYA	–	Chip Res, 1005 J 680KΩ
R134	KAMAYA	–	Chip Res, 1005 J 3.9MΩ
R135	TDK	–	Chip Cap,1005 K 0.1µF
R136	KAMAYA	–	Chip Res, 1005 J 100KΩ
R137	KAMAYA	–	Chip Res, 1005 J 4.7MΩ
R138	KAMAYA	–	Chip Res, 1005 J 220KΩ
R139	KAMAYA	–	Chip Res, 1005 J 10KΩ
R140	KAMAYA	–	Chip Res, 1005 J 68KΩ
R141	KAMAYA	–	Chip Res, 1005 J 100KΩ
R142	KAMAYA	–	Chip Res, 1005 J 330KΩ
R143	KAMAYA	–	Chip Res, 1005 J 100KΩ
R144	KAMAYA	–	Chip Res, 1005 J 100KΩ
R145	KAMAYA	–	Chip Res, 1005 J 1MΩ
R146	KAMAYA	–	Chip Res, 1005 J 0Ω
R147	KAMAYA	–	Chip Res, 1005 J 47KΩ
R148	KAMAYA	–	Chip Res, 1005 J 1MΩ
R149	KAMAYA	–	Chip Res, 1005 J 470KΩ
R150	KAMAYA	–	Chip Res, 1005 F 10KΩ
R151	KAMAYA	–	Chip Res, 1005 F 12KΩ
R152	KAMAYA	–	Chip Res, 1005 J 680Ω
R153	KAMAYA	–	Chip Res, 1005 F 68KΩ
R154	KAMAYA	–	Chip Res, 1005 F 47KΩ
R155	KAMAYA	–	Chip Res, 1005 J 470Ω
R156	KAMAYA	–	Chip Res, 1005 J 1KΩ
R157[2]	KAMAYA	–	Chip Res, 1005 J 1KW
R158[2]	KAMAYA	–	Chip Res, 1005 J 1KΩ
R159	KAMAYA	–	Chip Res, 1005 J 47KΩ
R160	KAMAYA	–	Chip Res, 1005 J 47KΩ
R161	KAMAYA	–	Chip Res, 1005 J 47KΩ
R162	KAMAYA	–	Chip Res, 1005 J 820Ω
R163	KAMAYA	–	Chip Res, 1005 J 100KΩ
R164	KAMAYA	–	Chip Res, 1005 J 100KΩ
R165	KAMAYA	–	Chip Res, 1005 J 3KΩ
R167	KAMAYA	–	Chip Res, 1005 J 100KΩ
R168	KAMAYA	–	Chip Res, 1005 J 100KΩ
R169	KAMAYA	–	Chip Res, 1005 J 1.2KΩ
R171	KAMAYA	–	Chip Res, 1005 J 10KΩ
R172	KAMAYA	–	Chip Res, 1005 J 10KΩ
R173	KAMAYA	–	Chip Res, 1005 J 10KΩ
R174	KAMAYA	–	Chip Res, 1005 J 100KΩ
R175	KAMAYA	–	Chip Res, 1005 J 51KΩ
R176	KAMAYA	–	Chip Res, 1005 J 24KΩ
R177	KAMAYA	–	Chip Res, 1005 J 20KΩ
R178	KAMAYA	–	Chip Res, 1005 J 100KΩ
R179	KAMAYA	–	Chip Res, 1005 J 51KΩ
R180	KAMAYA	–	Chip Res, 1005 J 100KΩ
R182	KAMAYA	–	Chip Res, 1005 J 200KΩ
R184	KAMAYA	–	Chip Res, 1005 J 15KΩ
R185	KAMAYA	–	Chip Res, 1005 J 0Ω

Circuit Ref.	Supplier	Supplier Part No.	Description
R190	KAMAYA	–	Chip Res, 1005 J 15KΩ
R193	KAMAYA	–	Chip Res, 1005 J 10KΩ
R194	KAMAYA	–	Chip Res, 1005 J 10KΩ
R195	KAMAYA	–	Chip Res, 1005 J 100Ω
R196	KAMAYA	–	Chip Res, 1005 J 47KΩ
R197	KAMAYA	–	Chip Res, 1005 J 47KΩ
R198	KAMAYA	–	Chip Res, 1005 J 47KΩ
R199	KAMAYA	–	Chip Res, 1005 J 47KΩ
R203	KAMAYA	–	Chip Res, 1005 J 22KΩ
R204	KAMAYA	–	Chip Res, 1005 J 22KΩ
R206	KAMAYA	–	Chip Res, 1005 J 10KΩ
R207	KAMAYA	–	Chip Res, 1005 J 22KΩ
R208	KAMAYA	–	Chip Res, 1005 J 12KΩ
R210	KAMAYA	–	Chip Res, 1005 J 120KΩ
R211	KAMAYA	–	Chip Res, 1005 J 15KΩ
R212	KAMAYA	–	Chip Res, 1005 J 33KΩ
R213	KAMAYA	–	Chip Res, 1005 J 3.3KΩ
R216	KAMAYA	–	Chip Res, 1005 J 10KΩ
R217	KAMAYA	–	Chip Res, 1005 J 10KΩ
R220	KAMAYA	–	Chip Res, 1005 J 5.6KΩ
R250	KAMAYA	–	Chip Res, 1005 J 10KΩ
R258	KAMAYA	–	Chip Res, 1005 J 1.5KΩ
R302	KAMAYA	–	Chip Res, 1005 J 56KΩ
R309	KAMAYA	–	Chip Res, 1005 J 100Ω
R310	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R311	KAMAYA	–	Chip Res, 1005 J 330Ω
R312	KAMAYA	–	Chip Res, 1005 J 150KΩ
R314	KAMAYA	–	Chip Res, 1005 J 100Ω
R315	KAMAYA	–	Chip Res, 1005 J 100Ω
R316	KAMAYA	–	Chip Res, 1005 J 100KΩ
R317	KAMAYA	–	Chip Res, 1005 J 180KΩ
R318	KAMAYA	–	Chip Res, 1005 J 3.3KΩ
R319	KAMAYA	–	Chip Res, 1005 J 3.3KΩ
R320	KAMAYA	–	Chip Res, 1005 J 100Ω
R323	KAMAYA	–	Chip Res, 1005 J 100KΩ
R330	KAMAYA	–	Chip Res, 1005 J 100KΩ
R332	KAMAYA	–	Chip Res, 1005 J 100KΩ
R333	KAMAYA	–	Chip Res, 1005 J 100KΩ
R334	KAMAYA	–	Chip Res, 1005 J 100KΩ
R335	KAMAYA	–	Chip Res, 1005 J 2.2KΩ
R336	KAMAYA	–	Chip Res, 1005 J 1KΩ
R337	KAMAYA	–	Chip Res, 1005 J 100Ω
R338	KAMAYA	–	Chip Res, 1005 J 100Ω
R401	KAMAYA	–	Chip Res, 1005 J 180Ω
R402	KAMAYA	–	Chip Res, 1005 J 39Ω
R403	KAMAYA	–	Chip Res, 1005 J 180Ω
R404	KAMAYA	–	Chip Res, 1005 J 8.2KΩ
R405	KAMAYA	–	Chip Res, 1005 J 1.5KΩ
R406	KAMAYA	–	Chip Res, 1005 J 22Ω
R407	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R408	KAMAYA	–	Chip Res, 1005 J 2.2KΩ
R409	KAMAYA	–	Chip Res, 1005 J 10Ω
R410	KAMAYA	–	Chip Res, 1005 J 10Ω
R411	KAMAYA	–	Chip Res, 1005 J 560Ω
R412	KAMAYA	–	Chip Res, 1005 J 1KΩ
R413	KAMAYA	–	Chip Res, 1005 J 8.2KΩ
R414	KAMAYA	–	Chip Res, 1005 J 1KΩ
R415	KAMAYA	–	Chip Res, 2012 J 220Ω
R416	KAMAYA	–	Chip Res, 1608 J 47KΩ
R417	ROHM	–	Chip Res, 1W J 2512 0.1Ω
R418	KAMAYA	–	Chip Res, 1608 D 220KΩ
R419	KAMAYA	–	Chip Res, 1608 D 220KΩ
R420	KAMAYA	–	Chip Res, 1005 J 4.7MΩ
R421	KAMAYA	–	Chip Res, 1608 D 68KΩ
R422	KAMAYA	–	Chip Res, 1608 D 68KΩ
R423	KAMAYA	–	Chip Res, 1005 J 3.9MΩ
R424	KAMAYA	–	Chip Res, 1005 J 12KΩ
R425	KAMAYA	–	Chip Res, 1005 J 3.9KΩ
R426	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R427	KAMAYA	–	Chip Res, 1005 J 220KΩ
R428	KAMAYA	–	Chip Res, 1005 J 100Ω
R429	KAMAYA	–	Chip Res, 1005 J 3.6KΩ
R430	KAMAYA	–	Chip Res, 1005 J 100Ω
R431	KAMAYA	–	Chip Res, 1005 J 10KΩ
R432	KAMAYA	–	Chip Res, 1005 J 27KΩ
R433	KAMAYA	–	Chip Res, 1005 J 0Ω
R434	KAMAYA	–	Chip Res, 1005 J 33KΩ
R435	KAMAYA	–	Chip Res, 1005 J 150Ω
R436	KAMAYA	–	Chip Res, 1005 J 100Ω
R440	KAMAYA	–	Chip Res, 1005 J 15KΩ
R441	KAMAYA	–	Chip Res, 1005 J 0Ω
R501	KAMAYA	–	Chip Res, 1005 J 220Ω
R502	KAMAYA	–	Chip Res, 1005 J 220Ω
R503	KAMAYA	–	Chip Res, 1005 J 56KΩ
R504	NOBLE	–	Chip Semi V.R, 3PIE 47 KΩ
R505	KAMAYA	–	Chip Res, 1005 J 12KΩ
R506	KAMAYA	–	Chip Res, 1005 J 10KΩ
R507	KAMAYA	–	Chip Res, 1005 J 10KΩ
R508	KAMAYA	–	Chip Res, 1005 J 3.6KΩ
R509	KAMAYA	–	Chip Res, 1005 J 2.2KΩ

Circuit Ref.	Supplier	Supplier Part No.	Description
R510	KAMAYA	–	Chip Res, 1005 J 15KΩ
R511	KAMAYA	–	Chip Res, 1005 J 8.2KΩ
R512	KAMAYA	–	Chip Res, 1005 J 20KΩ
R513	KAMAYA	–	Chip Res, 1005 J 10KΩ
R514	KAMAYA	–	Chip Res, 1005 J 15KΩ
R515	KAMAYA	–	Chip Res, 1005 J 20KΩ
R516	KAMAYA	–	Chip Res, 1005 J 2.2KΩ
R517	KAMAYA	–	Chip Res, 1005 J 15KΩ
R518	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R519	KAMAYA	–	Chip Res, 1005 J 4.7MΩ
R520	KAMAYA	–	Chip Res, 1005 J 1MΩ
R521	KAMAYA	–	Chip Res, 1005 J 330KΩ
R523	KAMAYA	–	Chip Res, 1005 F 30KΩ
R524	KAMAYA	–	Chip Res, 1005 F 47KΩ
R526	NOBLE	–	Chip Semi V.R, 2PIE 47 KΩ
R527	KAMAYA	–	Chip Res, 1005 J 82KΩ
R528	KAMAYA	–	Chip Res, 1005 J 82KΩ
R529	KAMAYA	–	Chip Res, 1005 J 47KΩ
R530	KAMAYA	–	Chip Res, 1005 J 47KΩ
R531	KAMAYA	–	Chip Res, 1005 J 47KΩ
R532	KAMAYA	–	Chip Res, 1005 J 10KΩ
R533	KAMAYA	–	Chip Res, 1005 J 10KΩ
R534	KAMAYA	–	Chip Res, 1005 J 10KΩ
R535	KAMAYA	–	Chip Res, 1005 J 10KΩ
R536	KAMAYA	–	Chip Res, 1005 J 330KΩ
R537	KAMAYA	–	Chip Res, 1005 J 1KΩ
R538	KAMAYA	–	Chip Res, 1005 J 10KΩ
R539	KAMAYA	–	Chip Res, 1005 J 330KΩ
R540	KAMAYA	–	Chip Res, 1005 J 47KΩ
R541	KAMAYA	–	Chip Res, 1005 J 330KΩ

Circuit Ref.	Supplier	Supplier Part No.	Description
R609	KAMAYA	–	Chip Res, 1005 J 1KΩ
R610	KAMAYA	–	Chip Res, 1005 J 2.2Ω
R613	KAMAYA	–	Chip Res, 1005 J 15KΩ
R614	KAMAYA	–	Chip Res, 1005 J 390KΩ
R615	KAMAYA	–	Chip Res, 1005 J 2.2Ω
R616	KAMAYA	–	Chip Res, 1005 J 0Ω
R619	KAMAYA	–	Chip Res, 1005 J 10KΩ
R620	KAMAYA	–	Chip Res, 1005 J 33KΩ
R621	KAMAYA	–	Chip Res, 1005 J 39KΩ
R622	KAMAYA	–	Chip Res, 1005 J 0Ω
R623	KAMAYA	–	Chip Res, 1005 J 560Ω
R701	KAMAYA	–	Chip Res, 1005 J 56Ω
R702	KAMAYA	–	Chip Res, 1005 J 1.5KΩ
R703	KAMAYA	–	Chip Res, 1005 F 4.7KΩ
R704	KAMAYA	–	Chip Res, 1005 F 4.7KΩ
R705	KAMAYA	–	Chip Res, 1005 J 220Ω
R706	KAMAYA	–	Chip Res, 1005 J 100Ω
R707	KAMAYA	–	Chip Res, 1005 J 1.5KΩ
R708	KAMAYA	–	Chip Res, 1005 F 4.7KΩ
R709	KAMAYA	–	Chip Res, 1005 F 6.8KΩ
R710	KAMAYA	–	Chip Res, 1005 J 220Ω
R711	KAMAYA	–	Chip Res, 1005 J 100KΩ
R712	KAMAYA	–	Chip Res, 1005 J 100KΩ
R713	KAMAYA	–	Chip Res, 1005 J 30KΩ
R714	KAMAYA	–	Chip Res, 1005 J 56Ω
R715	KAMAYA	–	Chip Res, 1005 J 56Ω
R716	KAMAYA	–	Chip Res, 1005 J 300Ω
R717	KAMAYA	–	Chip Res, 1005 J 10Ω
R718	KAMAYA	–	Chip Res, 1005 J 7.5KΩ
R719	KAMAYA	–	Chip Res, 1005 J 1KΩ

Circuit Ref.	Supplier	Supplier Part No.	Description
R720	KAMAYA	–	Chip Res, 1005 J 150Ω
R721	KAMAYA	–	Chip Res, 1005 J 150Ω
R722	KAMAYA	–	Chip Res, 1005 J 10KΩ
R723	KAMAYA	–	Chip Res, 1005 J 1KΩ
R724	KAMAYA	–	Chip Res, 1005 J 390Ω
R725	KAMAYA	–	Chip Res, 1005 J 100Ω
R726	KAMAYA	–	Chip Res, 1005 J 3KΩ
R727	KAMAYA	–	Chip Res, 1005 J 2.7KΩ
R728	KAMAYA	–	Chip Res, 1005 J 2.7KΩ
R729	KAMAYA	–	Chip Res, 1005 J 100KΩ
R730	KAMAYA	–	Chip Res, 1005 J 33KΩ
R731	KAMAYA	–	Chip Res, 1005 J 10Ω
R732	KAMAYA	–	Chip Res, 1005 J 10KΩ
R733	KAMAYA	–	Chip Res, 1005 J 0Ω
R734	KAMAYA	–	Chip Res, 1005 J 10Ω
R735	KAMAYA	–	Chip Res, 1005 J 1KΩ
R736	KAMAYA	–	Chip Res, 1005 J 1KΩ
R737	KAMAYA	–	Chip Res, 1005 J 1KΩ
R740	KAMAYA	–	Chip Res, 1005 J 1.5KΩ
R1001	KAMAYA	–	Chip Res, 1005 J 10KΩ
R1002	KAMAYA	–	Chip Res, 1005 J 9.1KΩ
R1003	KAMAYA	–	Chip Res, 1005 J 10KΩ
R1004	KAMAYA	–	Chip Res, 1005 J 10KΩ
R1005	TDK	–	Chip Cap, 1005 K 10nF
RT201	TAIYOYUDEN	–	Thermistor, 103K
RT501	TAIYOYUDEN	–	Thermistor, 103K
SH101	BGTech	8860BEACA1010	Shield CAN, VCO
SH102	BGTech	8860BEAC93010	Shield CAN, PLL
SH103	BGTech	8660BEACA4010	Shield CAN, PA
SH105	MOTOROLA	PMDN4149AR	Finger Strip TX

Circuit Ref.	Supplier	Supplier Part No.	Description
SH201	MOTOROLA	PMDN4151AR	Finger Strip–Pair
SPK1	BGTech	8400362424100	SHINMYUNG, Speaker, 24Ω 1.0W 36θ(Connector type)
SW/ VOL1	BGTech	84766N992N151	TOKOS, Switch Volume, RY-8418 Rev1
U101	BGTech	81100303RF020	RENESAS, CPU IC, M3030RFCPGP
U102	BGTech	8116AK2347020	ASAHI KASEL, AUDIO LSI, AK2347
U103	BGTech	8192088L70020	ZERLINK, DTMF RECEIVER, MT88L70
U104	BGTech	811324LC64020	MIRCO CHIP, EEPROM IC, 24LC64
U105	JRC	–	OP AMP, NJM324
U106	BGTech	8135TC7S66020	TOSHIBA, Analog SW IC, TC7S66FU
U107	BGTech	81287027AT020	VOLTAGE DETECTOR, KIA7027AT
U201	BGTech	8125311360020	TOSHIBA, FM IC, TA31136
U202	BGTech	8191401150220	MIRCOCHIP, DIGITAL POTENTIOMETER, MCP4011(502)
U401	KEC	–	OP AMP (DUAL), KIA358
U402	BGTech	8191401150220	MIRCOCHIP, DIGITAL POTENTIOMETER, MCP4011(502)
U501	JRC	–	JRC, OP AMP, NJM324
U502	JRC	–	JRC, OP AMP, NJM324
U505	BGTech	8123011250021	TOKO, REGULATOR IC, TK11250AMTL
U506	BGTech	8123112330020	TOKO, REGULATOR IC, TK11233AMTL
U507	BGTech	8128TC1240020	MICRO CHIP, VOLTAGE DOUBLER, TC1240
U508	BGTech	8191401150320	MIRCO CHIP,DIGITAL POTENTIOMETER, MCP4011(503)
U601	BGTech	811608541T020	PHILIPS, AUDIO AMP,TDA8541
U701	BGTech	810415E03S020	FUJISU, PLL IC, MB15E03SLPFV1–G–BND–EF–6
PCB1	BGTech	8431BEACON200	CAFSYSTEM, Main PCB, FR4 4 Layer PCB Rev.#P4
KEY PCB1	BGTech	8422BEACON100	CAFSYSTEM, Key PCB, 1.2T 2Layer

Note:
2: Not for PMUE3144AAL

Notes

Chapter 8 136 – 174 MHz VHF Theory Of Operation

8.1 Introduction

This chapter provides a detailed theory of operation for the radio components. Schematic diagrams for the circuits described in the following paragraphs are located in Chapter 10 of this manual.

8.2 VHF Receiver

The VHF receiver design covers the frequency range of 136 – 174 MHz and it is a double conversion super heterodyne with 1st IF 45.1 MHz and 2nd IF 455 kHz. The receiver is divided into two major blocks, Front End and Back End as shown in Figure 8-1.

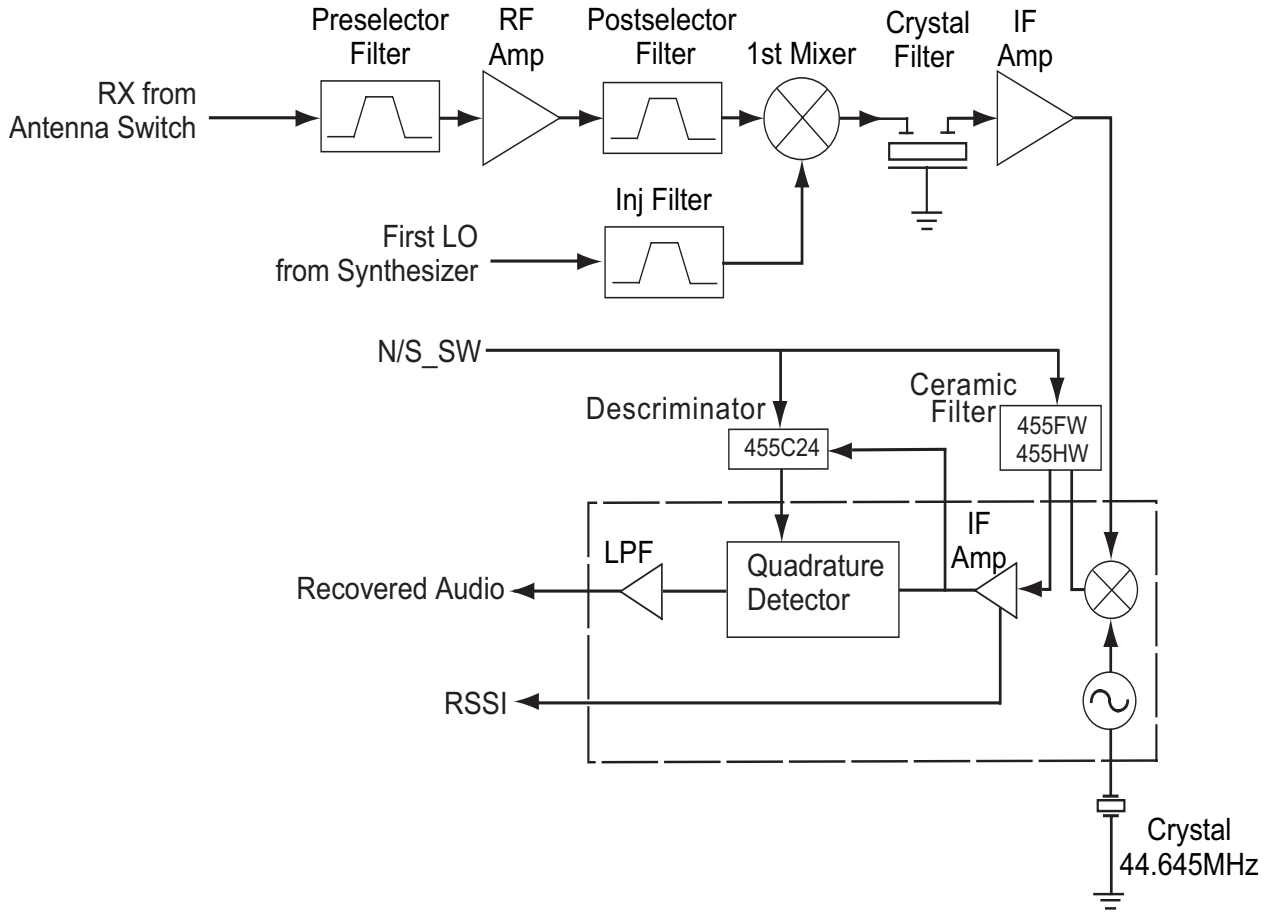


Figure 8-1. VHF Receiver Block Diagram

8.2.1 Receiver Front End

Incoming RF signals from antenna are first routed through the harmonic filter (L409, L410, L411, C426, C427, C428, C429, C445, C446) and antenna switch (CR301), part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of preselector filter, RF amplifier, post-selector filter and a single-balanced mixer.

The preselector filter is a varactor-tuned 2-pole design using discrete elements (L301, L302, L303, L304, C301, C304, C305, C307) in a shunt or series resonator configuration. It is a band-shift filter and the frequency shift is controlled by varactor diodes CR302 and CR303, which are connected to the microprocessor. It is configured to provide steeper attenuation above the passband for improved spurious rejection when high-side local injection is used. The frequency is separated into 6 steps and controlled by CPU (136 – 174 MHz).

The output of this filter is matched to the base of RF amplifier Q301 which provides 15dB of gain.

The output of the RF amplifier is applied to the post-selector filter. The post-selector filter designed using discrete elements (L307, L308, L309, L311, C315 and C354) in a series/shunt resonator configuration. It is a band-shift filter and the frequency shift is controlled by varactor diodes CR305 and CR307, which are connected to the microprocessor. It is configured to provide steeper attenuation above the passband for improved spurious rejection when low-side local injection is used. The frequency is separated into 6 steps and controlled by CPU (136 – 174 MHz).

The output of the post selector is connected to the single-balanced mixer consisting of components L329, L333, Q306 and Q307. 1st local signal generated from VCO is filtered by injection filter (L310, L331, C325, C326, C327, C333 and C365) to remove second harmonics. The converted 1st IF frequency at mixer passes through L331 and matches the 45.1 MHz IF signal to pair crystal filter (FL301).

8.2.2 Receiver Back End

The 1st IF signal is amplified about 15 dB by IF amp Q303. The output of the IF amp is connected to IF IC (U201). 1st IF frequency (45.1 MHz) and 2nd LO frequency (44.645 MHz) are mixed in U201. The second mixer converts the 45.1 MHz high IF frequency to 2nd IF frequency (455 kHz).

Additional IF selectivity is provided by two ceramic filters (CF1, CF2). The wider filter 455 FW is used for 25 kHz channel spacing, and the narrower filter 455 HW is used for 12.5 kHz channel spacing. These two ceramic filters may eliminate undesired signal and demodulated by demodulator in U201. N/S_SW which connected to microprocessor is used to select the wide and narrow band.

The mute (squelch) circuit switches off the audio amplifier when no audio is present. The squelch circuit consists of U201 and U202 and their associated components. The noise signal from pin 9 of U201 is used to control the squelch circuit sensitivity of U202. The noise passes through filter, and is amplified by internal amp of U201. The amplified noise act as a DC voltage to control the mute system. So if the noise level is under the threshold voltage, the microprocessor (U101) un-mutes the radio. If the noise level is over the threshold voltage, the microprocessor mutes the radio. The squelch level is tuned in the factory. When a component or a part in the RX system is replaced, the squelch must be re-tuned using the Tuner.

8.3 VHF Transmitter

The VHF transmitter covers the range of 136 – 174 MHz. Depending on model, the output power of the transmitter is switchable on a per-channel basis between high power (5 Watts) and low power (1 Watt). The transmitter is divided into four major blocks as shown in Figure 8-2.

- Power Amplifier
- Harmonic Filter
- Power Control

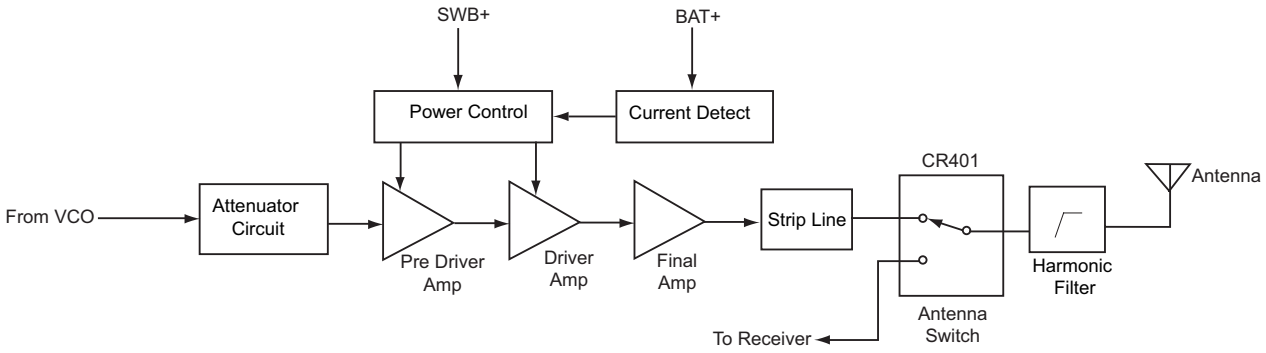


Figure 8-2. VHF Transmitter Block Diagram

8.3.1 Power Amplifier

The transmitter power amplifier has three stages of amplification – Pre Driver (Q401), Driver Amp (Q402) and Final Amp (Q403). Signal from TX VCO is applied to the pre driver via an attenuator circuit. The attenuator is pie style resistor attenuator, and is used as isolation between VCO and the power amps. The -3dBm TX RF signal from attenuator is then amplified by pre driver and driver amp to around +28dBm and is applied to the final amp. The final amp (Q403) is an enhancement-mode N-channel MOSFET device providing a gain of 12dB. The device drain current is drawn directly from the DC battery supply voltage input via L413. A matching network consisting of C417, C418, C419, C420, C455 and a strip line, transforms the impedance to approximately 50 Ohm.

8.3.2 Antenna Switch

An antenna switch works mainly as a switching device between transmit and receive paths. In transmit mode (PTT), Q407 is turned on and both PIN diodes (CR401, CR301) are forward biased into conduction. This enables the RF signal to pass to the harmonic filter and then to the antenna. In the receiver mode, both diodes are off. Signals applied to the antenna jack are routed via the LPF (harmonic filter), through a TX Low Pass Filter (L409, L410, L411, C426, C427, C428, C429, C430, C445 and C446), to the receiver input.

8.3.3 Harmonic Filter

The harmonic filter consists of components L409, L410, L411, C426, C427, C428, C429, C430, C445 and C446. The harmonic filter is a seven-pole Chebychev filter.

8.3.4 Auto Power Control

The APC keeps the current supply constant to the final amp (Q403). The drain current of Q403 (final amp) is sensed across resistor R417. The voltage difference across R417. The differential signal at the output of U401 (pin 7) is passed to Q404 and Q405 that produces a constant power output to the antenna. If the current is changed due to change of battery voltage or load, APC controls gate voltage of Q403 and collector voltage of Q401 and drain voltage of Q402 to keep TX power stable. This circuit stabilizes TX power at a pre-determined level adjusted by U402. This bias voltage is tuned in the factory. If the transistor (Q403) is replaced, the RF Output Power must be tuned. By tuning the RF output power, the bias voltage will be tuned through U402. Extra care has to be taken during the tuning process. Do not exceed the maximum allowed bias voltage.

8.4 VHF Frequency Generation Circuitry

The PLL synthesizer subsystem consists of the reference oscillator (VCTCXO), VCO, PLL IC, Charge Pump and Loop Filter.

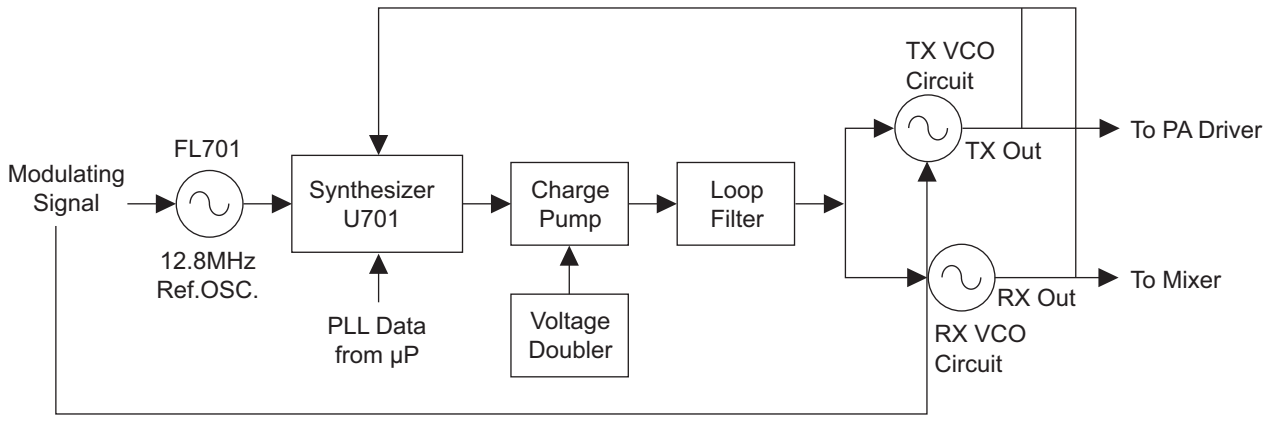


Figure 8-3. VHF Frequency Generation Unit Block Diagram

8.4.1 Reference Oscillator (12.8 MHz VCTCXO)

The reference oscillator is powered by regulated 5V provided by U505. The reference frequency 12.8 MHz VCTCXO (Voltage Controlled Temperature Compensated Crystal Oscillator) is applied to the PLL IC (U701) via pin 1. Main frequency can be adjusted by chip trimmer of VCTCXO. This frequency provides reference to the PLL IC and has a frequency stability of +/-2.5PPM (max) at the temperature ranging from -30 to +60 Degree Celsius.

8.4.2 PLL IC Prescaler and Comparator

The reference frequency from VCTCXO is divided to 6.25 kHz or 5 kHz by reference counter, R. The RF signal input from the VCO is divided to by prescaler (1/64), divided by N and A counters in PLL IC to determine frequency steps and then supplied to the comparator. The comparison frequency is 6.25/5 kHz. The internal phase comparator compares the phase difference between the reference and VCO signal. When the phase of the reference frequency is leading, Pin15 (R) is the output. When VCO frequency is leading, Pin16 (P) is the output. When P=R, small pulses are the output of the phase detector.

8.4.3 Voltage Doubler and Charge Pump

The voltage doubler (U507) converts 5V to 10V and is applied to the charge pump circuitry. The charge pump is used for charging output signals P, R supplied by PLL IC from 0-3.3V to 0-10V. This voltage is used to drive the VCO.

8.4.4 Loop Filter

The loop filter contains C751, C752, C753, C754, R726, R727, R728. It reduces the residual side-band noise to get the best signal-to-noise ratio. The output signal from loop filter is applied to VCO.

8.4.5 Dual VCO

The dual VCO module contains a RX VCO and a TX VCO. They are configured as colpitts oscillators and connected to power up through transistor switches. Only one VCO is selected at a time. A steering line voltage between 0.35V and 9.7V at varactor CR701 tunes the full RX frequency range from 181.1 MHz to 219.1 MHz, and varactor CR703 tunes the full TX frequency range from 136 MHz to 174 MHz.

In Receiver mode, high signal of RX_EN from pin 71, U101 activates Q305. When Q305 is activated, current flows through the base of Q304 and thus activates the Q705. The varactor CR701 sets the resonance frequency. When there is a change in voltage supplied by loop filter, there is a change in the resonance frequency. L703 is the resonating coil, which forms the tank circuit together with variable cap C710.

In Transmit mode, high signal of TX_EN1 from pin 84, U101 enables current flows through collector of Q503 and thus activates Q706. The varactor CR703 sets the resonance frequency. When there is a change in voltage supplied by loop filter, there is a change in the resonance frequency. L706 is the resonating tuning coil, which forms the tank circuit together with variable cap C722.

8.5 Keypad

Left, Right and P1 to P3 keys are directly connected to microprocessor via 22 pin connector. When any of these keys is pressed, the voltage goes "low" and microprocessor detects it.

For full keypad models, the number keys are in matrix type which consisted of 3 rows and 4 columns. When any of these keys is pressed, the voltage goes "low" and microprocessor interprets the voltage for each key press.

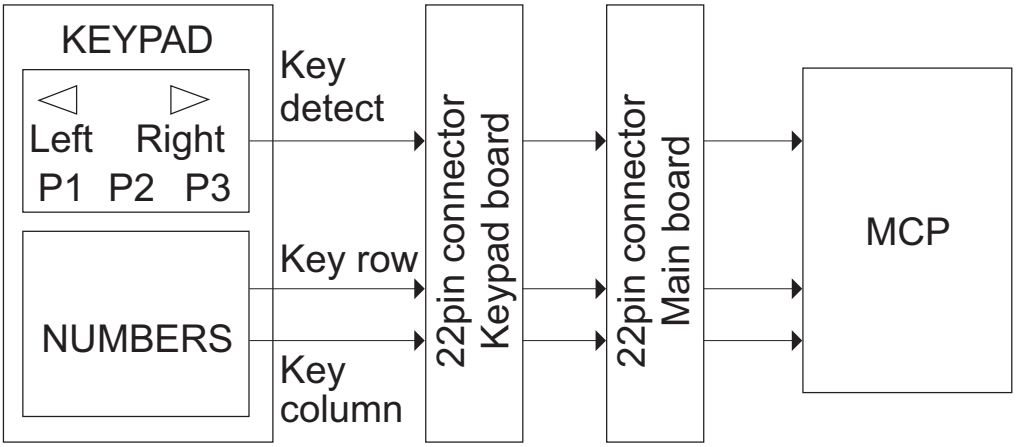


Figure 8-4. Keypad Block Diagram

Chapter 9 VHF Troubleshooting Tables

9.1 Troubleshooting Table for Receiver (VHF)

Table 9-1. Troubleshooting Table for Receiver (VHF)

Symptom	Possible Causes	Procedure	Corrective Action
Radio Dead (no turn–on beep, no LED indication)	1. Battery dead or defective	Substitute good battery or battery eliminator	Change or replace battery.
	2. Defective battery contacts	Inspect battery contacts for corrosion or bent terminals	Clean/Repair/Replace J602
	3. Microprocessor not starting up	Verify clock input to U101 pin 13 is 7.3728 MHz using high impedance probe. Verify U101 pin10(reset) is high.	Troubleshoot/Replace FL101. If reset is Low, troubleshoot regulator U506 or U107.
	4. Regulator fault	Verify U506 pin 4 is 3.3V Verify U505 pin 4 is 5.0V	Check for shorts on outputs Troubleshoot/Repair as needed, replace faulty regulator
	5. Flexible Cable fault	Check connection of the 12 pin flexible cable between J104 & J105	Re–assemble or replace flexible cable
No RX Audio (with LED indication)	1. Speaker dead or defective	Substitute a good housing (with speaker) Verify J603 connection	Change the housing (with accessory) Change the housing (with accessory)
	2. Audio Processor IC not starting up	Verify clock input U102 pin 14 is 3.5795 MHz using high impedance probe.	Troubleshoot/Replace FL102
	3. Audio Amp IC not starting up right	Verify U601 pin 6 is battery voltage. If battery voltage is being supplied to pin 6, then verify audio output at pin5&8.	Troubleshoot/Replace U601
No Receive (with no LED indication)	1. IF IC dead or fault	Verify clock input to U201 pin 1&2 is 44.645 Mhz using high impedance probe.	Troubleshoot/Replace FL201
No RX	1. RX–B+	Verify Q304's collector voltage is 4.8V when RX–EN is high.	Check/Replace Q304

9.2 Troubleshooting Table for Synthesizer (VHF)

Table 9-2. Troubleshooting Table for Synthesizer (VHF)

Symptom	Possible Causes	Procedure	Corrective Action
Synthesizer Out of Lock (No RX Mode)	1. Defective 12.8 MHz VCTCXO	Verify clock output FL701 pin 3 is 12.8 MHz using high impedance probe.	Repair/Replace FL701
	2. 1/2VCC defective	Verify FL701 pin 1, U502–B pin 5& U502–D pin 14 voltage is 1.9V.	Troubleshoot: 1/2VCC circuitry
	3. No RX–Enable	Verify U101 pin 71 (RX–EN1) is high. Verify Q304 collector voltage is approximately 4.7V in RX mode	Check U101 operating Troubleshoot: Q304 & Q305 circuitry
	4. Check PLL–LD port	Verify U101 pin 27 is Low (Normal Mode) Verify U101 pin 27 is swept from low to high (Power Save Mode)	Troubleshoot: PLL circuitry. Repair/Replace U701
Synthesizer Out of Lock (No TX Mode)	1. Defective 12.8 MHz VCTCXO	Verify clock output FL701 pin 3 is 12.8 MHz using high impedance probe.	Repair/replace FL701
	2. 1/2VCC defective	Verify FL701 pin 1, U502–B pin 5 & U502–D pin 14 voltage is 1.9V.	Troubleshoot: 1/2VCC circuitry
	3. No TX–Enable	Verify U101 pin 84(TX–EN1) is high when PTT is pressed. Verify Q407 collector voltage is approximately 4.7V when PTT is pressed (TX–EN2).	Check U101 operating Check U101–pin 85 is high/ Replace Q407/check LK2 is short
	4. Check PLL–LD port	Verify U101 pin 27 is Low (Normal Mode) Verify U101 pin 27 is swept from low to high (Power Save Mode)	Troubleshoot: PLL circuitry Repair/Replace U701

9.3 Troubleshooting Table for Transmitter (VHF)

Table 9-3. Troubleshooting Table for Transmitter (VHF)

Symptom	Possible Causes	Procedure	Corrective Action
No internal Mic audio	1. Mic dead or defective	Verify audio present (~10mV rms) when speaking into Mic. Check bias of R194 (3.3V).	Replace Mic.
	2. Mic bias fault	Verify U101 pin 78 is 1.1V when PTT button is pressed.	Check/Replace U101
	3. Audio Processor IC not starting up right	Verify clock input U102 pin 14 is 3.5795 MHz using high impedance probe.	Troubleshoot/Replace FL102
No EXT. Mic audio	1. J601 defective	Check connection with EXT mic	Check/Replace J601
	2. Audio Processor IC not starting up right	Verify clock input U102 pin 14 is 3.579545 MHz using high impedance probe.	Troubleshoot/Replace FL102
No transmit (No TX LED indication)	1.PTT switch defective	Verify U101 pin 44 is low when PTT is pressed.	Replace PTT switch PB501
No transmit (TX LED indication OK)	1. Synthesizer out of lock	Refer to Table 9-2	Check U101 operating
	2. No TX–Enable	Verify U101 pin 84 (TX–EN1) is high when PTT is pressed. Verify Q407 collector voltage is approximately 4.7V when PTT is pressed (TX–EN2).	Check U101 pin 85 is high/ Replace Q407/Check LK2 is short
Low Power	1. Low TX injection	Check the RF level at Q7 & C449 per schematic.	Troubleshoot Q409 circuitry & VCO bias
	2. R417 defective	Verify resistance is 0.1 Ohm	Replace R417.
	3. Incorrect control voltage	Verify Q404 collector voltage is approximately 5.5V in low frequency & high power.	Troubleshoot APC circuitry Replace Q404
	4. Q403 defective (High current)	Verify U401 pin 7 is near 0V	Replace Q403
	5. Antenna switch defect	Verify CR401 anode voltage is approximately 1.4V	Check/replace CR401 & CR301
	6. Harmonic filter defective	Visually inspect components C426 – C429, C445, C446, C430	Repair/Replace if necessary
	7. Incorrect power tuning (this has to be performed only after item 1-6 has been checked)	Check conducted power	Re–tune power using tuner.
Poor TX range (Conducted power OK)	1. Defective or wrong Antenna.	Verify correct antenna is installed. Try using another antenna.	Replace antenna

9.4 Troubleshooting Table for Board and IC Signals (VHF)

Table 9-4. Troubleshooting Table for Board and IC Signals (VHF)

IC Designator	Pin	Pin Function	DC Voltage (V)	Comments (Condition)
U201(IF IC)	1	Osc1	3.9	44.645 MHz input
	2	Osc2	3.3	
	4	VCC	4.7	
	9	Audio frequency	1.2	
	12	RSSI out	Approximately 1	At –47dBm(with conducted)
	13	N–DET(BUSY)	Low	At busy
	15	GND	0	
	16	RF input	1	45.1 MHz input
U701(PLL IC)	1	Reference OSC input	1.4	12.8 MHz input
	4	VCC	3.3	
	6	GND	0	
	7	XF IN	2.2	
	8	F IN	2.2	
	12	Power save	High	
	13	GND	0	
	14	LD_out	High	If pll unlock is low
	15	@P	2.4	
	16	@R	Low	
U601	1	Mode (Mute con)	0	
(Audio Amp.)	2	SVR	3.8	
	3	IN+	3.8	
	4	IN-	3.8	
	5	OUT-	3.8	
	6	VCC	7.5	This voltage depends on Battery
	7	GND	0	
	8	OUT+	3.8	
U103	1	IN+	1.6	

Table 9-4. Troubleshooting Table for Board and IC Signals (VHF) (Continued)

IC Designator	Pin	Pin Function	DC Voltage (V)	Comments (Condition)
(DTMF decoder)	2	IN-	1.6	
	3	GS	1.6	
	4	Vref	1.6	
	8	OSC1	1.6	3.579545 MHz input
	10	VSS	0	
	11	TOE	3.3	
	17	STD	High	At DTMF detecting
	18	EST	3.3	
	19	ST/GT	3.3	
	20	VDD	3.3	
FL701(VCTCXO)	1	VCON	1.9	
	2	GND	0	
	3	OSC out	osc	Generate the 12.8 MHz
	4	VCC	5	
Q206(N/S SW)	E	GND	0	
	B	N/S SW	12.5 kHz: Low	
	C	Collector	12.5 kHz: High 25 kHz: Low	
Q304	E	+5V	5	At RX Mode
	B	To Q305 collector	Low	
	C	RX_B+	4.7	
Q305	E	GND	0	At RX Mode
	B	RX_EN	High	
	C	To Q304 base	Low	
Q503	E	GND	0	At TX Mode
	B	TX_EN1	High	
	C	To Q706 base	Low	
Q407	E	+5V	5	At TX Mode
	B	To Q408 collector	Low	
	C	TXVB	4.7	
Q408	E	GND	0	At TX Mode
	B	TX_EN2	High	
	C	To Q407	Low	

Table 9-4. Troubleshooting Table for Board and IC Signals (VHF) (Continued)

IC Designator	Pin	Pin Function	DC Voltage (V)	Comments (Condition)
Q601	E	GND	0	
	B	Audio_MUTE_CON	Mute: Low	
			None Mute: High	
	C	Mode	Mute: High	
			None Mute: Low	

1. All voltages are measured with a high-impedance digital voltmeter and expressed in volts DC relative to ground (0V).
2. Voltages are measured with a DC input voltage of 7.50 + .02 volts DC applied to the battery connector (J602).
3. All voltages are measured in the squelched receive mode, unless otherwise indicated.
4. Voltages are identical for VHF and UHF models unless otherwise indicated.

Chapter 10 VHF Schematic Diagrams, Overlays, and Parts Lists

10.1 Introduction

This section provides schematic diagrams, overlays, and parts lists for the radio circuit boards and interface connections.

10.1.1 Notes For All Schematics and Circuit Boards

* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

1. Unless otherwise stated, resistance values are in Ohms (K = 1000), capacitance values are in nanofarads (nF), picofarads (pF) or microfarads (µF), and inductance values are in nanohenries (nH) or microhenries (µH).
2. DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. If the board has been removed from the chassis, the transmitter module mounting screws may be used for ground connection. (*Note: The antenna nut bracket is connected to ground.*) Operating mode dependent voltages are followed by (RX) for receive mode, (TX) for transmit mode, (UNSQ) for unsquelched mode, etc.
3. RF voltages on VHF models are measured with a Fluke model 85 RF probe. The indicated voltages expressed in mV (RF) are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 1mV (-47dBm) RF signal applied to the antenna jack ANT1/ANT.
4. RF voltages on UHF models are measured both with a high–impedance RF voltmeter having a bandwidth in excess of 500 MHz (levels are expressed in dBm) and with a Fluke model 85 RF probe [levels are expressed in mV (RF)]. These indicated voltages are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms, and are only approximate for UHF frequency measurements. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 1mV (-47dBm) RF signal applied to the antenna jack ANT1/ANT.
5. Audio voltages are measured with a high-impedance AC rms voltmeter. The indicated voltages are expressed in mV rms. Receive mode voltages are followed by (RX) and are measured with an on-channel signal with 1 kHz modulation at 60% deviation (3 kHz for 25 kHz channels, or 1.5 kHz for 12.5 kHz channels). Transmit mode voltages are followed by (TX) and are measured with a 1 kHz, 10 mV rms signal present at the external microphone input (accessory connector J601).

6. Reference Designators are assigned in the following manner:

Ref. No. Series	Circuit Block
101 – 199	Microprocessor & audio control circuits
1001 – 1099	Microprocessor & audio control circuits
201 – 299	IF IC circuit
301 – 399	Front-end and 1st Mixer
401– 499	Transmit RF stage & Auto power control
501 – 599	Base band & generating circuit
601– 699	Audio amplifier
701– 799	VCO & PLL Synthesizer

7. Circuit Block Interconnection Legend:

Name	Description
+5V	5 Volts (Regulated)
+3.3V	3.3 Volts (Regulated)
SWB+	Switched Battery Voltage
BAT+	Unswitched Battery voltage
+10V	Digital 10V(Regulated)
RESET	Low-line reset signal fromU107 to U101 Pin 10
TX_EN1	Transmit enable signal from U101 Pin 84
TX_EN2	Transmit enable signal from U101 Pin 85
TXVB	TX operating voltage
TX_AF3	TX audio signal from audio processor IC to TX Audio filter
TX_SUB_TONE	TX sub tone signal from audio processor IC to TX modulation.
RX_B+	RX operating voltage
RSSI	RX signal strength indication from IF IC to U101
Busy	RX detect signal from IF IC to U101
FTV	RX frequency shift voltage
RX_AF1	RX audio signal from IF IC to Audio processor IC
PLL_LD	PLL lock detect signal from PLL IC to U101
N/S SW	Channel space selectable Switch (12.5 kHz/25 kHz)
1/2VCC	1.9 volts (divided by U502-D)

10.1.2 Four Layer Circuit Board

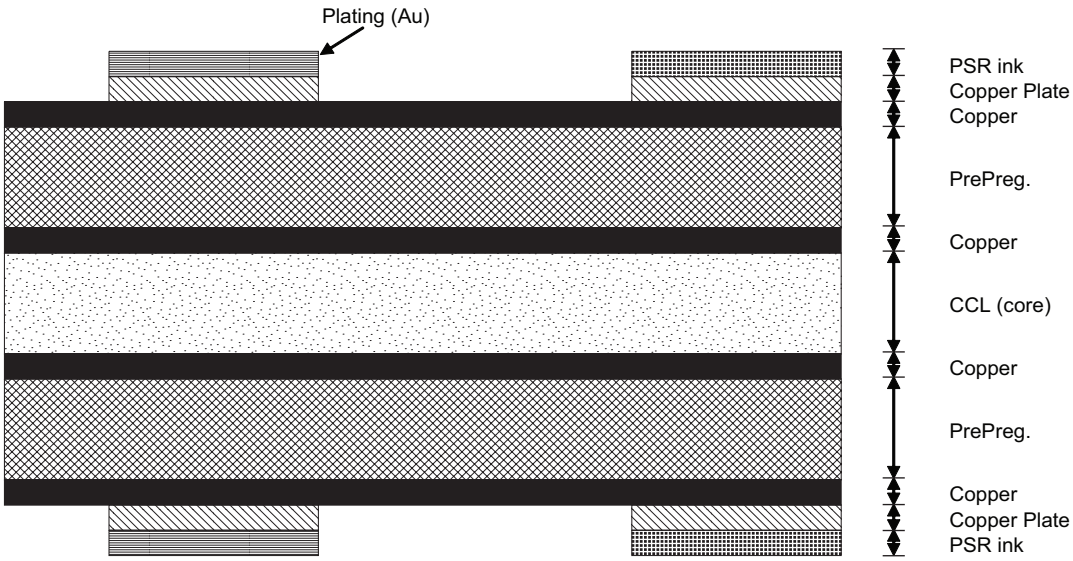


Figure 10-1. Four–Layer Circuit Board: Copper Steps in Layer Sequence

10.2 Speaker and Microphone Schematic

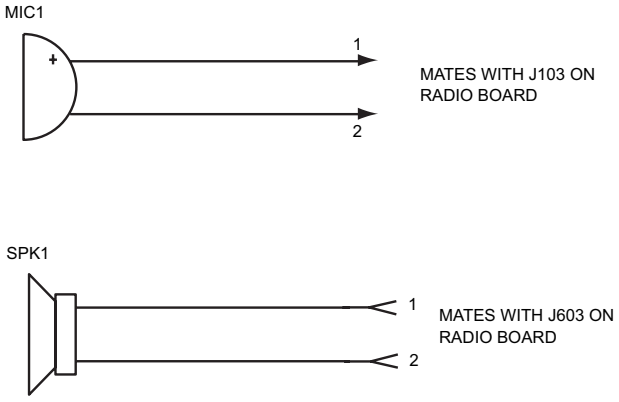


Figure 10-2. Speaker and Microphone Schematic

10.2.1 Speaker and Microphone Parts List

Reference Designator	Motorola Part No.	Description
MIC1	PMDN4139_R	Microphone
SPK1	PMDN4067BR	Speaker & Cable

10.3 Circuit Board/Schematic Diagram and Parts List (VHF: 136–174 MHz)

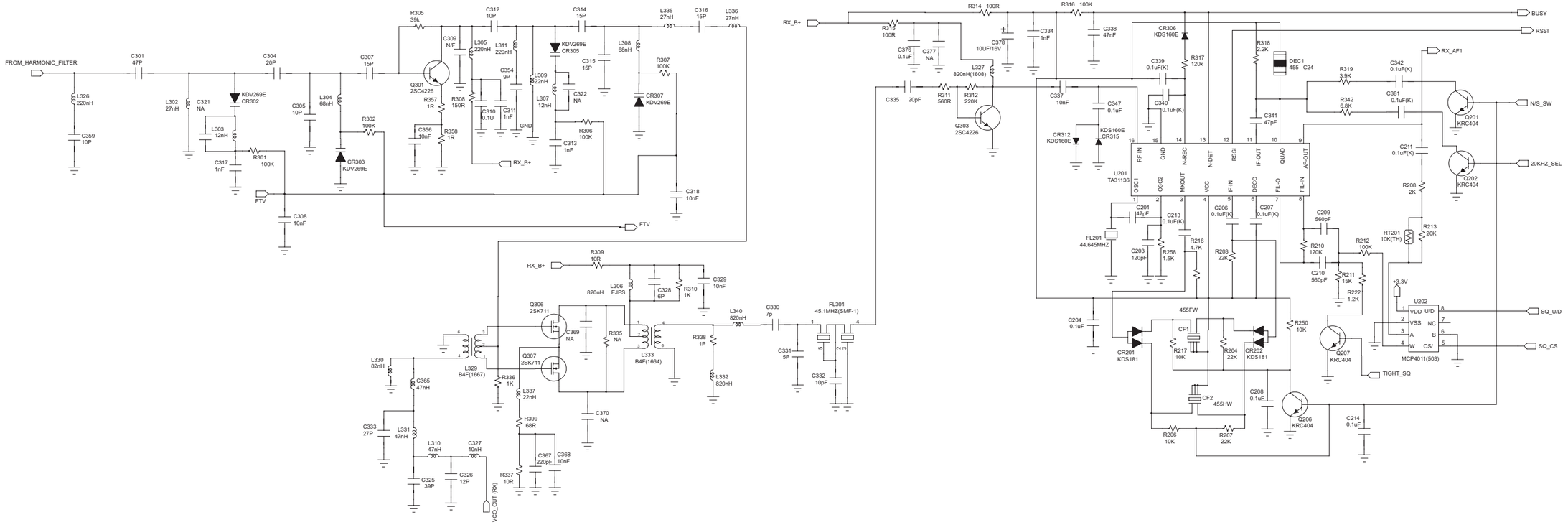


Figure 10-3. VHF (136–174 MHz) Receiver Schematic Diagram

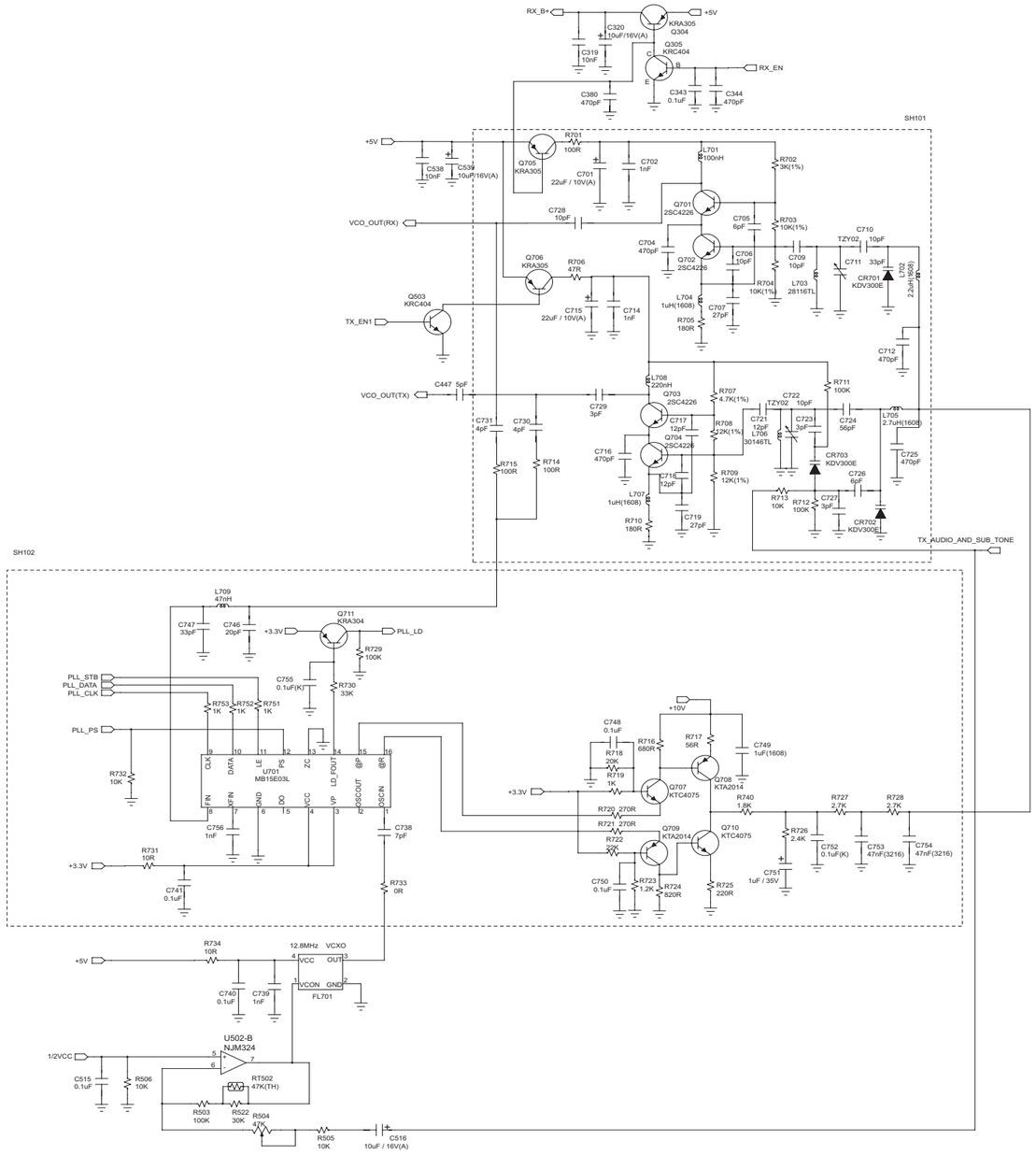


Figure 10-4. VCO and PLL Schematic Diagram

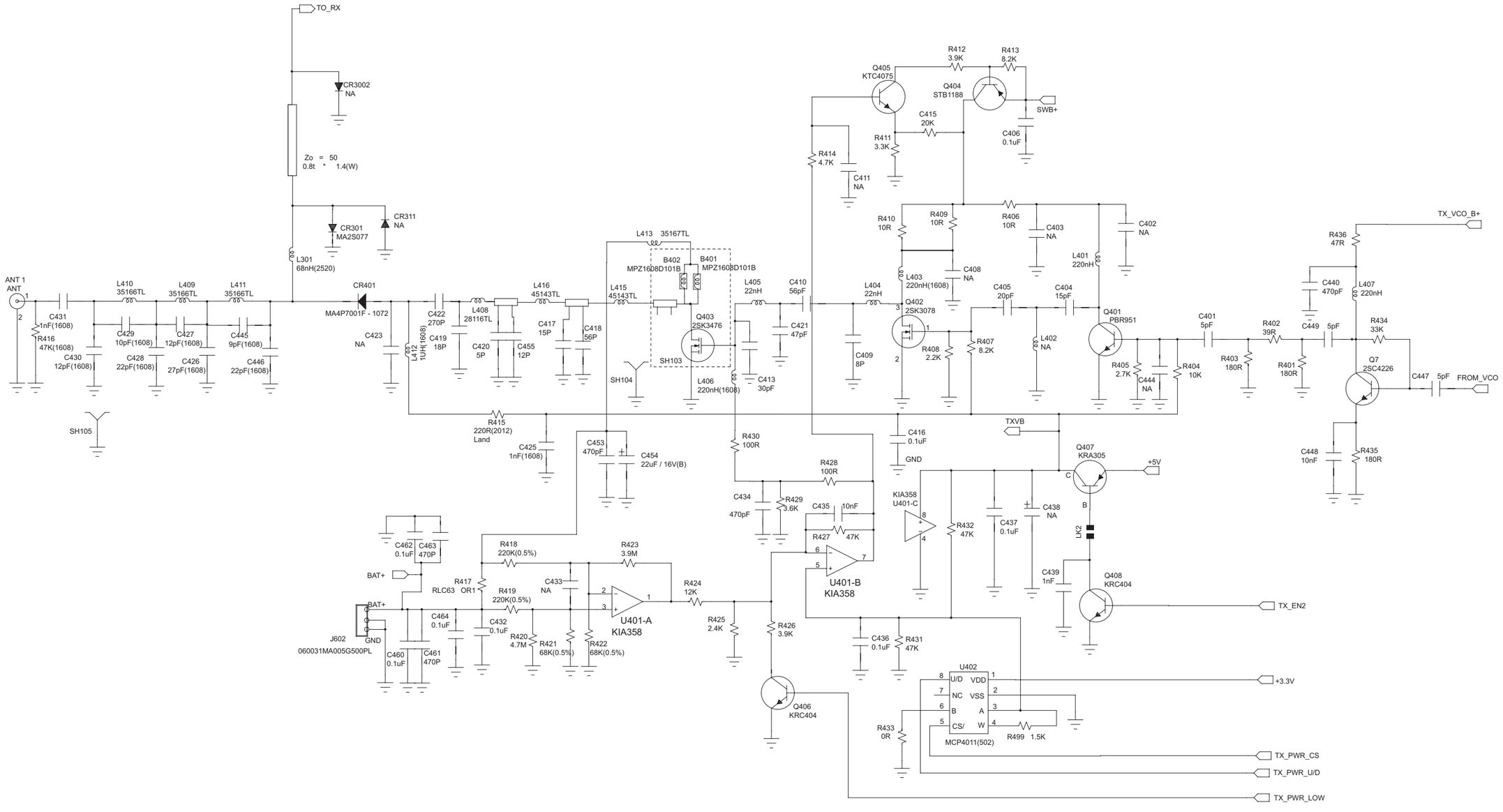


Figure 10-5. Transmitter Schematic Diagram

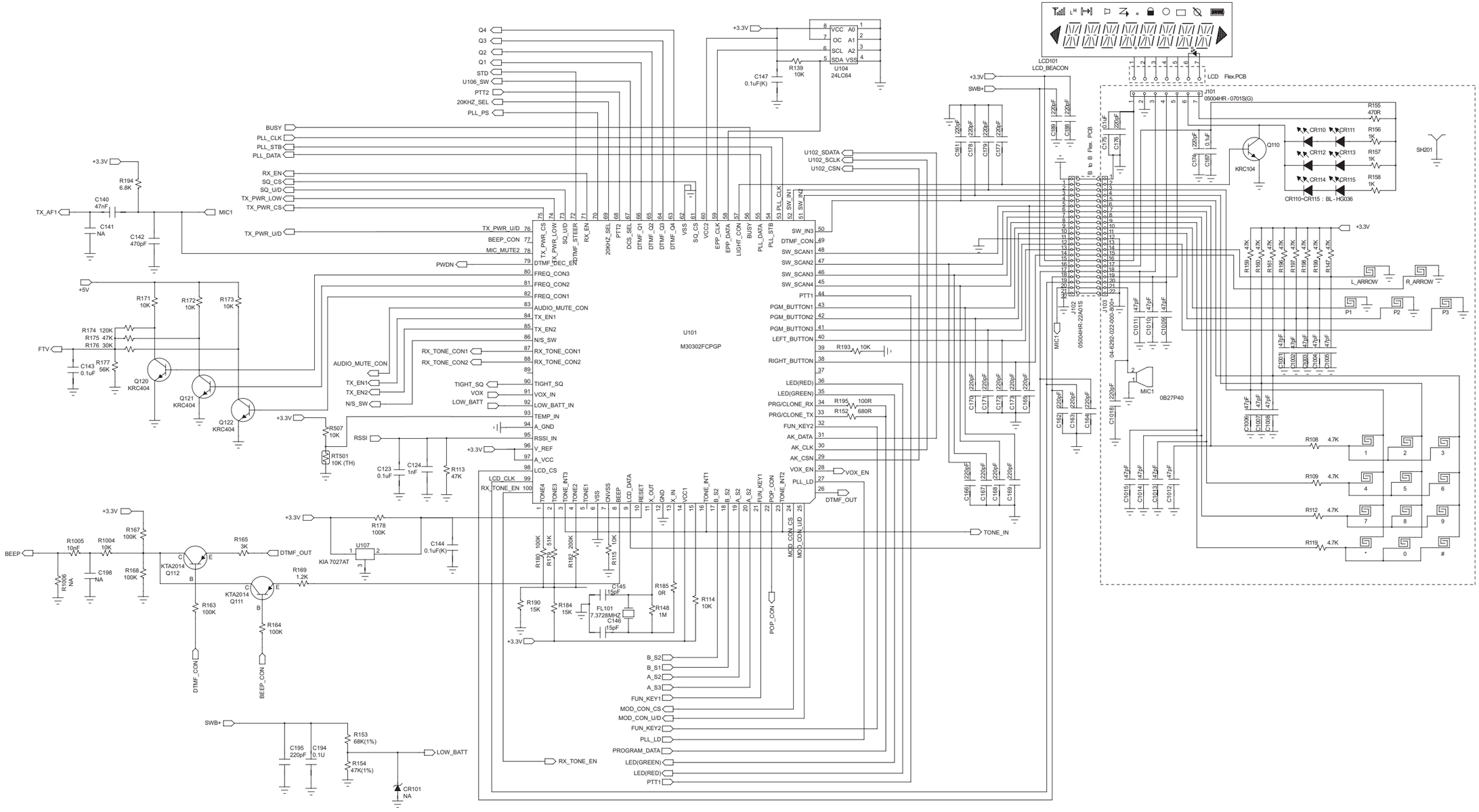


Figure 10-6. Microprocessor and Keypad Schematic Diagram

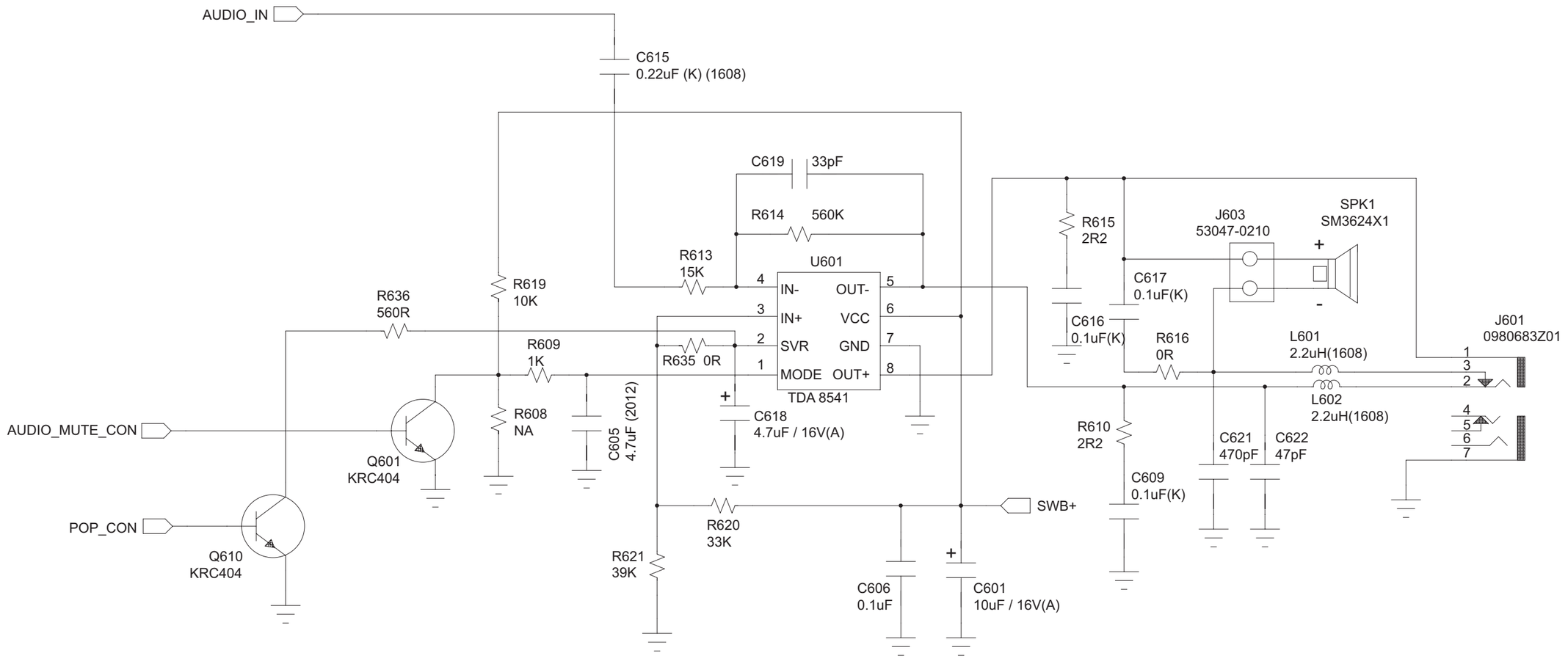


Figure 10-7. Audio Power Amplifier and External Audio Schematic Diagram

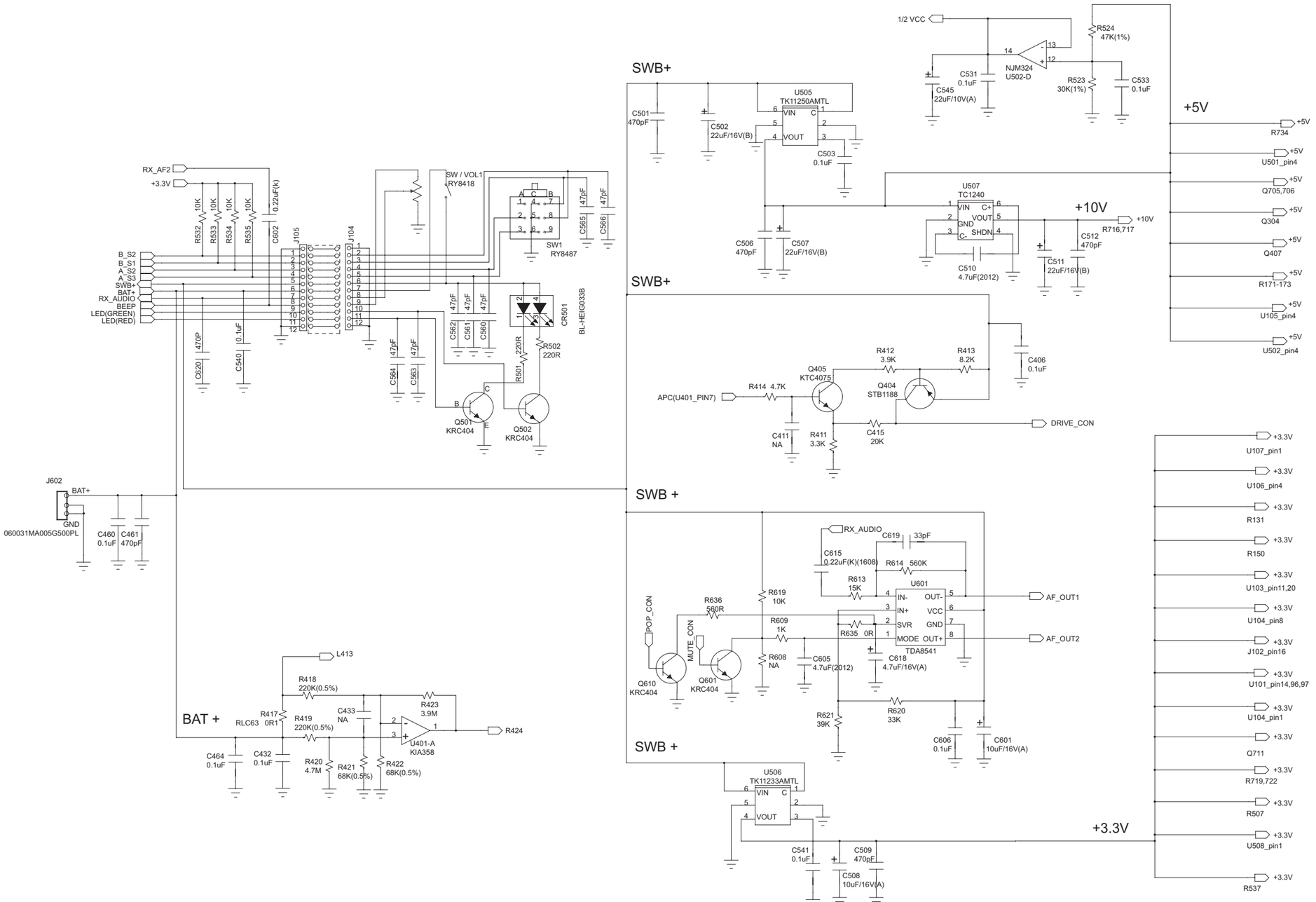


Figure 10-8. Switches and Battery Schematic Diagram

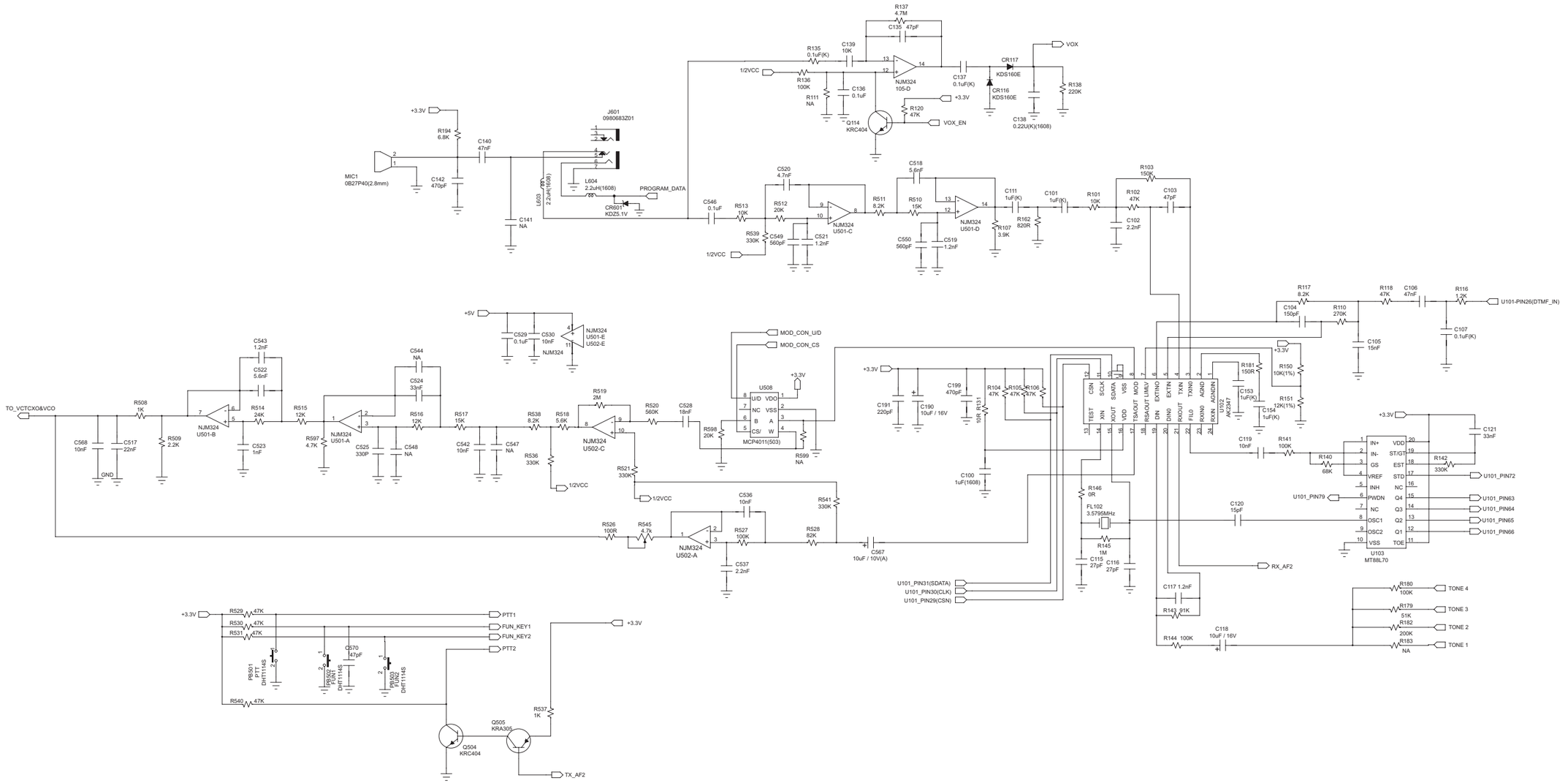


Figure 10-9. Transmitter Audio Filter and Sub-tone Schematic Diagram

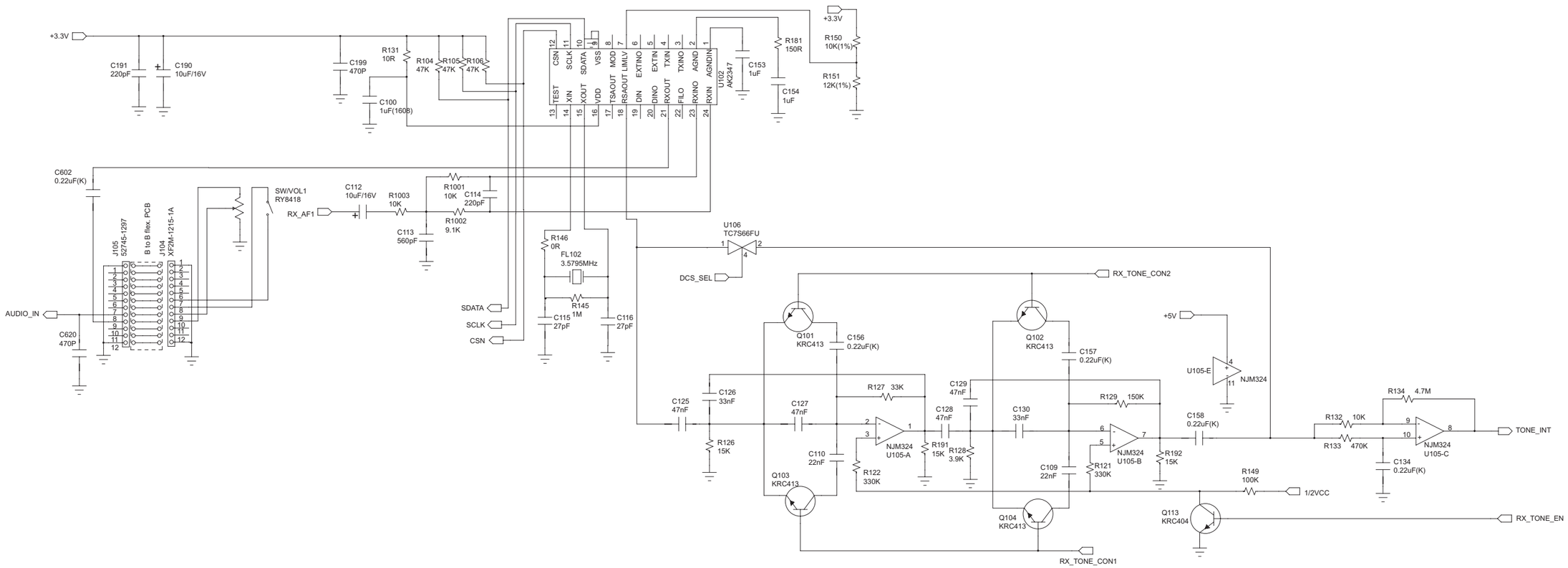


Figure 10-10. Receiver Audio Filter and Sub-tone Schematic Diagram

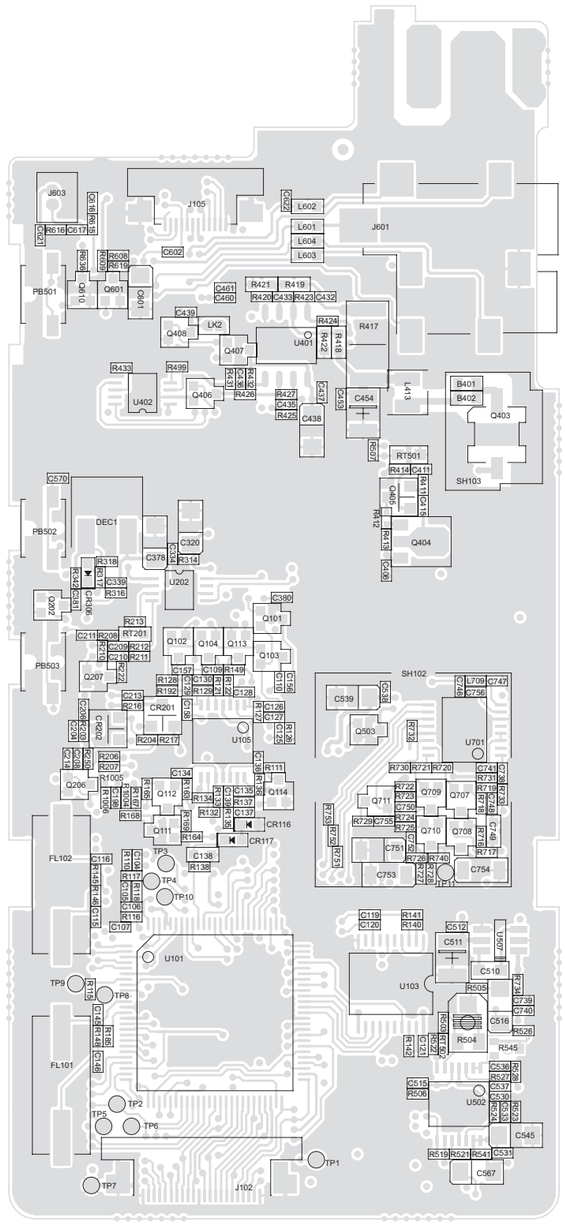


Figure 10-11. VHF (136–174 MHz) Mainboard Top Side: PCB No. 8431BEACON400

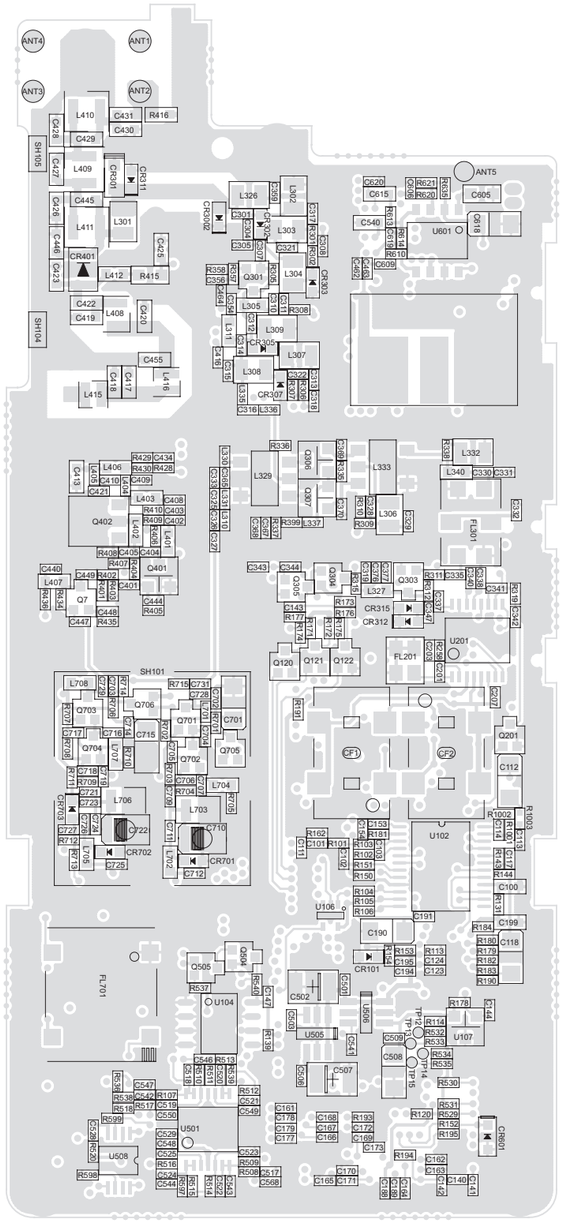


Figure 10-12. VHF (136–174 MHz) Mainboard Bottom Side: PCB No. 8431BEACON400

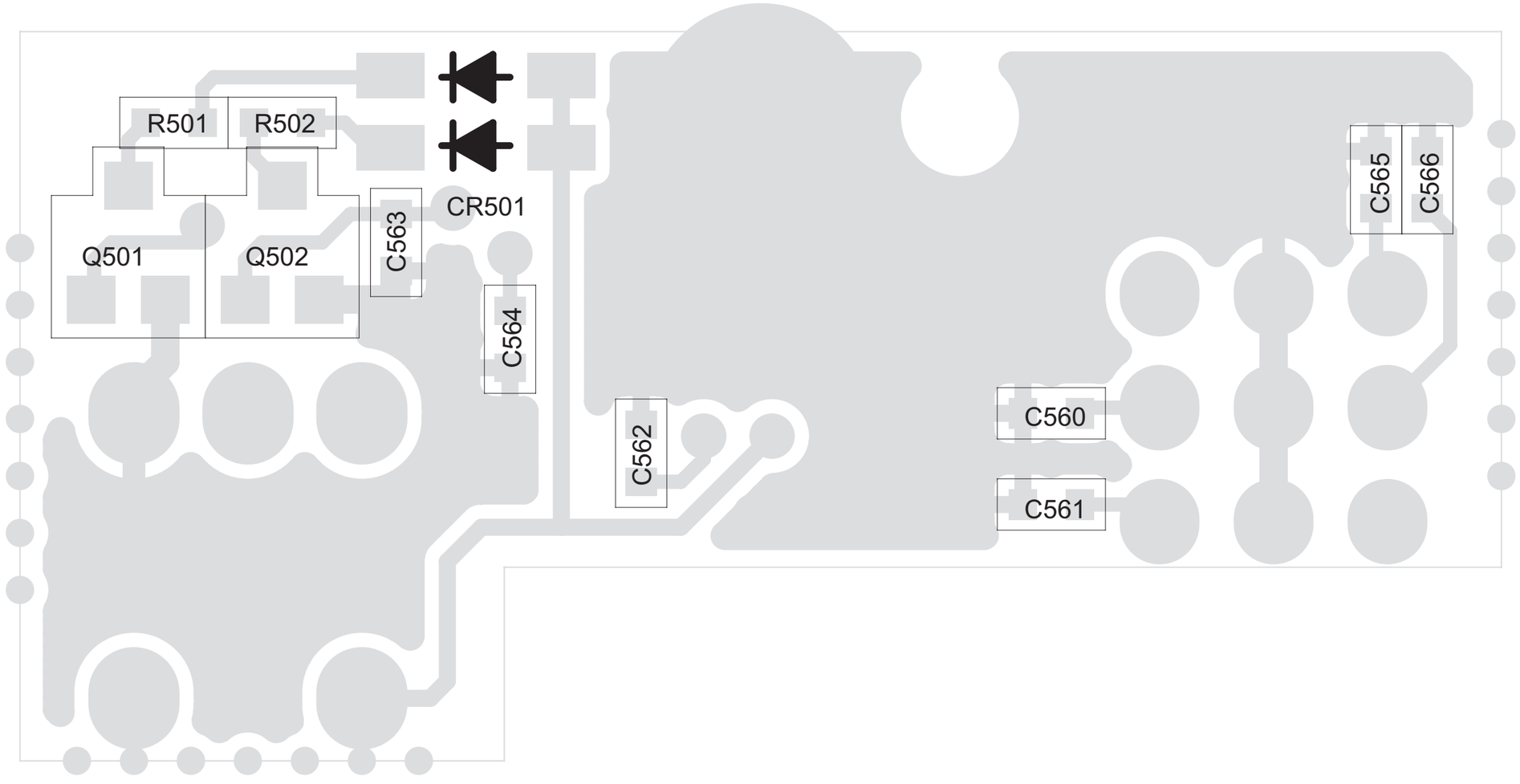


Figure 10-13. VHF (136–174 MHz) Sub Circuit Board Top View: PCB No. 8421BEACON100

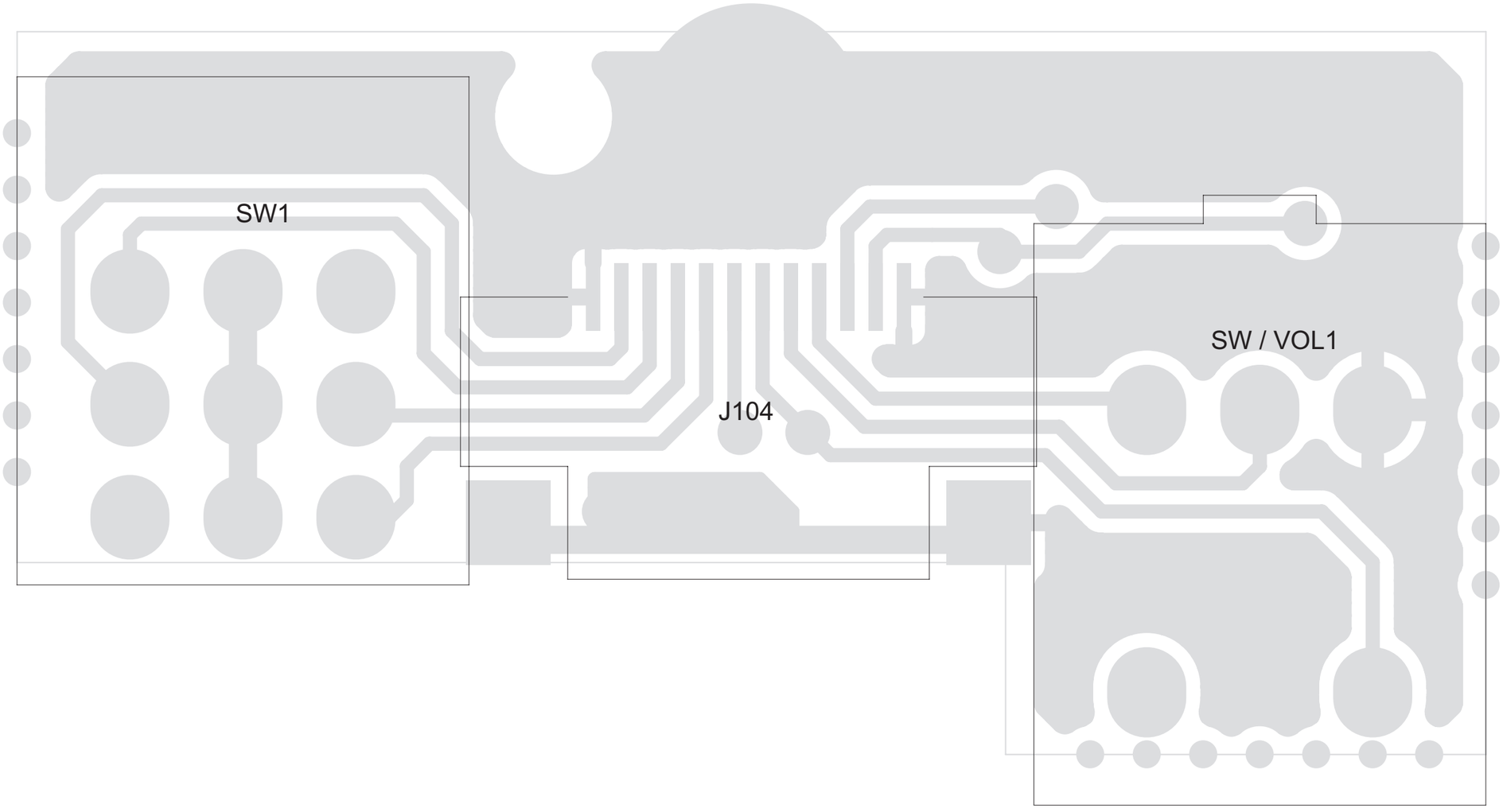
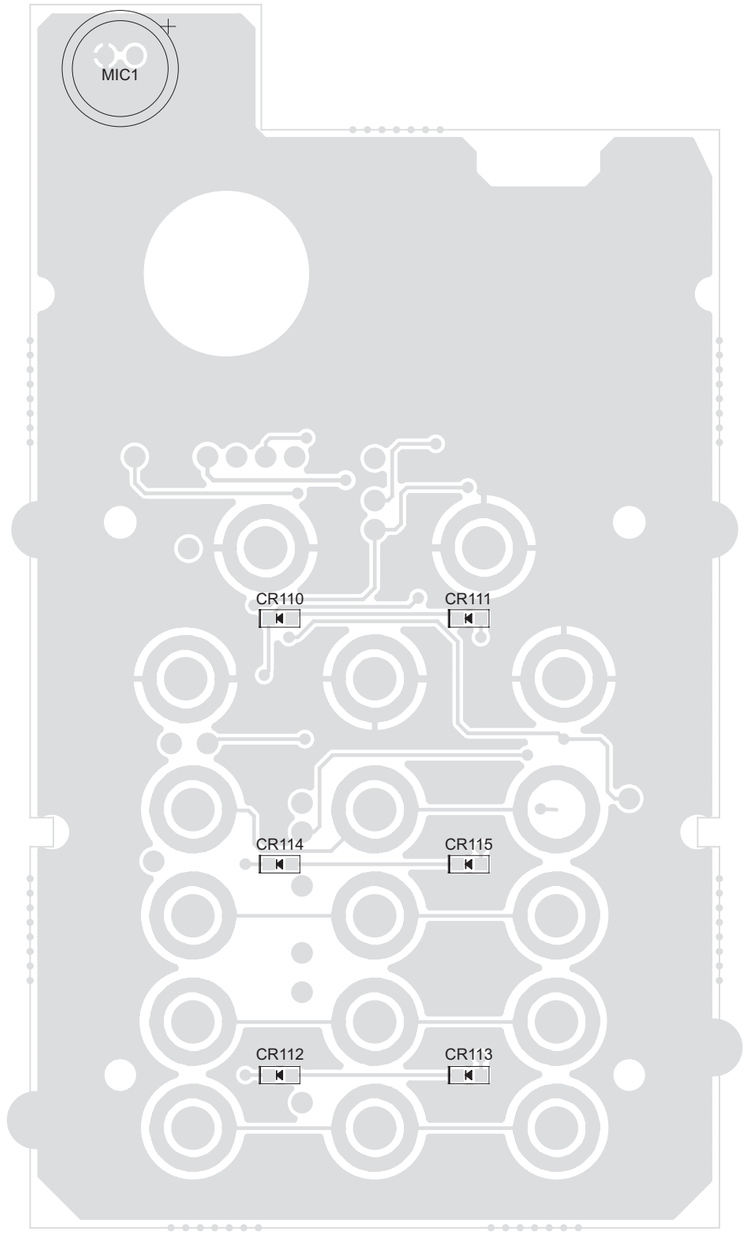


Figure 10-14. VHF (136–174 MHz) Sub Circuit Board Bottom View: PCB No. 8421BEACON100



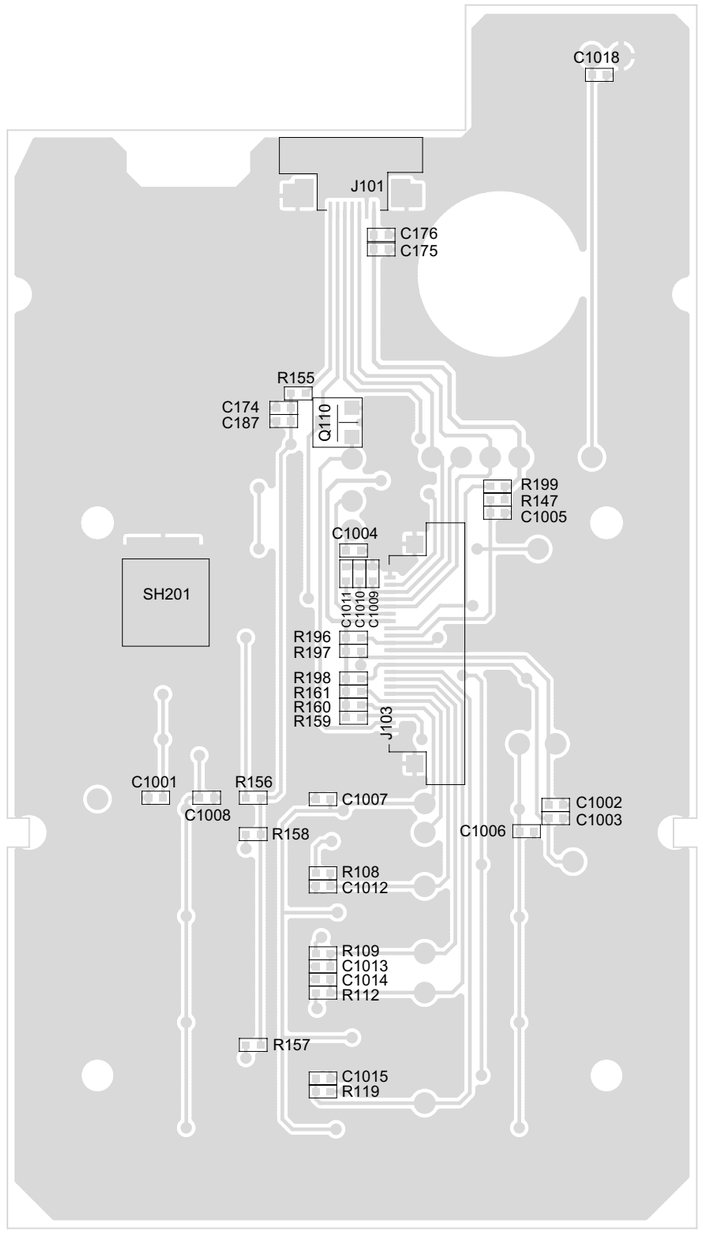


Figure 10-15. VHF (136–174 MHz) Keypad Board: PCB No. 8422BEACON100

10.3.1 Parts List

Circuit Ref.	Supplier	Supplier Part No.	Description
B401	TDK	–	Chip beads 1608 D 100Ω
B402	TDK	–	Chip beads 1608 D 100Ω
C100	TDK	–	Chip Cap, 1608 Z 1µF
C101	TDK	–	Chip Cap, 1005 K 1µF
C102	TDK	–	Chip Cap, 1005 K 2200PF
C103	TDK	–	Chip Cap, 1005 J 47PF
C104	TDK	–	Chip Cap, 1005 J 150 PF
C105	TDK	–	Chip Cap, 1005 K 15nF
C106	TDK	–	Chip Cap, 1005 K 47nF
C107	TDK	–	Chip Cap,1005 K 0.1µF
C109	TDK	–	Chip Cap,1005 K 22nF
C110	TDK	–	Chip Cap,1005 K 22nF
C111	TDK	–	Chip Cap, 1005 K 1µF
C112	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C113	TDK	–	Chip Cap,1005 K 560PF
C114	TDK	–	Chip Cap,1005 J 220PF
C115	TDK	–	Chip Cap, 1005 J 27PF
C116	TDK	–	Chip Cap, 1005 J 27PF
C117	TDK	–	Chip Cap, 1005 K 1.2nF
C118	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C119	TDK	–	Chip Cap,1005 K 10nF
C120	TDK	–	Chip Cap, 1005 J 15PF
C121	TDK	–	Chip Cap,1005 K 33nF
C123	TDK	–	Chip Cap,1005 Z 0.1µF
C124	TDK	–	Chip Cap,1005 K 1000PF
C125	TDK	–	Chip Cap, 1006 K 47nF
C126	TDK	–	Chip Cap,1005 K 33nF
C127	TDK	–	Chip Cap, 1006 K 47nF
C128	TDK	–	Chip Cap, 1006 K 47nF
C129	TDK	–	Chip Cap, 1006 K 47nF
C130	TDK	–	Chip Cap,1005 K 33nF
C134	TDK	–	Chip Cap,1005 K 0.2210nFµF
C135	TDK	–	Chip Cap, 1005 J 47PF
C136	TDK	–	Chip Cap,1005 Z 0.1µF
C137	TDK	–	Chip Cap,1005 K 0.1µF
C138	TDK	–	Chip Cap, 1608 K 0.22µF
C139	KAMAYA	–	Chip Res, 1005 J 10KΩ
C140	TDK	–	Chip Cap, 1006 K 473PF
C142	TDK	–	Chip Cap,1005 K 470PF
C143	TDK	–	Chip Cap,1005 Z 0.1µF
C144	TDK	–	Chip Cap,1005 K 0.1µF
C145	TDK	–	Chip Cap, 1005 J 15PF
C146	TDK	–	Chip Cap, 1005 J 15PF
C147	TDK	–	Chip Cap,1005 K 0.1µF
C153	TDK	–	Chip Cap, 1005 K 1µF
C154	TDK	–	Chip Cap, 1005 K 1µF
C156	TDK	–	Chip Cap,1005 K 0.22µF
C157	TDK	–	Chip Cap,1005 K 0.22µF
C158	TDK	–	Chip Cap,1005 K 0.22µF
C161	TDK	–	Chip Cap,1005 J 220PF
C162	TDK	–	Chip Cap,1005 J 220PF
C163	TDK	–	Chip Cap,1005 J 220PF
C164	TDK	–	Chip Cap,1005 J 220PF
C165	TDK	–	Chip Cap,1005 J 220PF
C166	TDK	–	Chip Cap,1005 J 220PF
C167	TDK	–	Chip Cap,1005 J 220PF
C168	TDK	–	Chip Cap,1005 J 220PF
C169	TDK	–	Chip Cap,1005 J 220PF
C170	TDK	–	Chip Cap,1005 J 220PF
C171	TDK	–	Chip Cap,1005 J 220PF
C172	TDK	–	Chip Cap,1005 J 220PF
C173	TDK	–	Chip Cap,1005 J 220PF
C174	TDK	–	Chip Cap,1005 J 220PF
C175	TDK	–	Chip Cap,1005 Z 0.1µF
C176	TDK	–	Chip Cap,1005 J 220PF
C177	TDK	–	Chip Cap,1005 J 220PF
C178	TDK	–	Chip Cap,1005 J 220PF
C179	TDK	–	Chip Cap,1005 J 220PF
C187	TDK	–	Chip Cap,1005 Z 0.1µF
C188	TDK	–	Chip Cap,1005 J 220PF
C189	TDK	–	Chip Cap,1005 J 220PF
C190	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C191	TDK	–	Chip Cap,1005 J 220PF
C194	TDK	–	Chip Cap,1005 Z 0.1µF
C195	TDK	–	Chip Cap,1005 J 220PF
C199	TDK	–	Chip Cap,1005 K 470PF
C201	TDK	–	Chip Cap, 1005 J 47PF
C203	TDK	–	Chip Cap,1005 J 120PF
C204	TDK	–	Chip Cap,1005 Z 0.1µF
C206	TDK	–	Chip Cap,1005 K 0.1µF
C207	TDK	–	Chip Cap,1005 K 0.1µF
C208	TDK	–	Chip Cap,1005 Z 0.1µF
C209	TDK	–	Chip Cap,1005 K 560PF
C210	TDK	–	Chip Cap,1005 K 560PF
C211	TDK	–	Chip Cap,1005 K 0.1µF
C213	TDK	–	Chip Cap,1005 K 0.1µF
C214	TDK	–	Chip Cap,1005 Z 0.1µF

Circuit Ref.	Supplier	Supplier Part No.	Description
C301	TDK	–	Chip Cap, 1005 J 47pF
C304	TDK	–	Chip Cap,1005 J 20PF
C305	TDK	–	Chip Cap, 1005 D 10PF
C307	TDK	–	Chip Cap, 1005 J 15PF
C308	TDK	–	Chip Cap,1005 K 10nF
C310	TDK	–	Chip Cap,1005 Z 0.1µF
C311	TDK	–	Chip Cap,1005 K 1000PF
C312	TDK	–	Chip Cap, 1005 D 10PF
C313	TDK	–	Chip Cap,1005 K 1000PF
C314	TDK	–	Chip Cap, 1005 J 15PF
C315	TDK	–	Chip Cap, 1005 J 15PF
C316	TDK	–	Chip Cap, 1005 J 15PF
C317	TDK	–	Chip Cap,1005 K 1000PF
C318	TDK	–	Chip Cap,1005 K 10nF
C319	TDK	–	Chip Cap,1005 K 10nF
C320	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C325	TDK	–	Chip Cap,1005 J 39PF
C326	TDK	–	Chip Cap, 1005 J 12PF
C327	TAIYOYUDEN	–	Chip Ind, 1005 J 10N
C328	TDK	–	Chip Cap,1005 D 6PF
C329	TDK	–	Chip Cap,1005 K 10nF
C330	TDK	–	Chip Cap, 1005 D 7PF
C331	TDK	–	Chip Cap, 1005 C 5PF
C332	TDK	–	Chip Cap, 1005 D 10PF
C333	TDK	–	Chip Cap, 1005 J 27PF
C334	TDK	–	Chip Cap,1005 K 1000PF
C335	TDK	–	Chip Cap,1005 J 20PF
C337	TDK	–	Chip Cap,1005 K 10nF
C338	TDK	–	Chip Cap, 1005 K 47nF
C339	TDK	–	Chip Cap,1005 K 0.1µF

Circuit Ref.	Supplier	Supplier Part No.	Description
C340	TDK	–	Chip Cap,1005 K 0.1µF
C341	TDK	–	Chip Cap, 1005 J 47PF
C342	TDK	–	Chip Cap,1005 K 0.1µF
C343	TDK	–	Chip Cap,1005 Z 0.1µF
C344	TDK	–	Chip Cap,1005 K 470PF
C347	TDK	–	Chip Cap,1005 Z 0.1µF
C354	TDK	–	Chip Cap,1005 D 9PF
C356	TDK	–	Chip Cap,1005 K 10nF
C359	TDK	–	Chip Cap, 1005 D 10PF
C365	TAIYOYUDEN	–	Chip Ind, 1005 J 47N
C367	TDK	–	Chip Cap,1005 J 220PF
C368	TDK	–	Chip Cap,1005 K 10nF
C376	TDK	–	Chip Cap,1005 Z 0.1µF
C378	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C380	TDK	–	Chip Cap,1005 K 470PF
C381	TDK	–	Chip Cap,1005 K 0.1µF
C401	TDK	–	Chip Cap,1005 C 5PF
C404	TDK	–	Chip Cap, 1005 J 15PF
C405	TDK	–	Chip Cap,1005 J 20PF
C406	TDK	–	Chip Cap,1005 Z 0.1µF
C409	TDK	–	Chip Cap,1005 D 8PF
C410	TDK	–	Chip Cap, 1005 J 56PF
C413	TDK	–	Chip Cap,1608 J 30PF
C415	KAMAYA	–	Chip Res, 1005 J 20KΩ
C416	TDK	–	Chip Cap,1005 Z 0.1µF
C417	TDK	–	Chip Cap, 1608 J 15PF
C418	TDK	–	Chip Cap,1608 J 56PF
C419	TDK	–	Chip Cap,1608 J 18PF
C420	TDK	–	Chip Cap,1608 C 5PF
C421	TDK	–	Chip Cap, 1005 J 47PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C422	TDK	–	Chip Cap,1608 J 270PF
C425	TDK	–	Chip Cap,1608 K 1000PF
C426	TDK	–	Chip Cap,1608 J 27PF
C427	TDK	–	Chip Cap,1608 J 12PF
C428	TDK	–	Chip Cap,1608 J 22PF
C429	TDK	–	Chip Cap,1608 D 10PF
C430	TDK	–	Chip Cap,1608 J 12PF
C431	TDK	–	Chip Cap,1608 J 1nF
C432	TDK	–	Chip Cap,1005 Z 0.1µF
C434	TDK	–	Chip Cap,1005 K 470PF
C435	TDK	–	Chip Cap,1005 K 10nF
C436	TDK	–	Chip Cap,1005 Z 0.1µF
C437	TDK	–	Chip Cap,1005 Z 0.1µF
C439	TDK	–	Chip Cap,1005 K 1000PF
C440	TDK	–	Chip Cap,1005 K 470PF
C445	TDK	–	Chip Cap,1608 D 9PF
C446	TDK	–	Chip Cap,1608 J 22PF
C447	TDK	–	Chip Cap,1005 C 5PF
C448	TDK	–	Chip Cap,1005 K 10nF
C449	TDK	–	Chip Cap,1005 C 5PF
C453	TDK	–	Chip Cap,1005 K 470PF
C454	HITACH	–	Chip Tantal, 22uF-M/ 16V(B)
C455	TDK	–	Chip Cap,1608 J 12PF
C460	TDK	–	Chip Cap,1005 Z 0.1µF
C461	TDK	–	Chip Cap,1005 K 470PF
C462	TDK	–	Chip Cap,1005 Z 0.1µF
C463	TDK	–	Chip Cap,1005 K 470PF
C464	TDK	–	Chip Cap,1005 Z 0.1µF
C501	TDK	–	Chip Cap,1005 K 470PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C502	HITACH	–	Chip Tantal, 22uF-M/ 16V(B)
C503	TDK	–	Chip Cap,1005 Z 0.1µF
C506	TDK	–	Chip Cap,1005 K 470PF
C507	HITACH	–	Chip Tantal, 22uF-M/ 16V(B)
C508	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C509	TDK	–	Chip Cap,1005 K 470PF
C510	TDK	–	Chip Cap, 2012 Z 4.7µF
C511	HITACH	–	Chip Tantal, 22uF-M/ 16V(B)
C512	TDK	–	Chip Cap,1005 K 470PF
C515	TDK	–	Chip Cap,1005 Z 0.1µF
C516	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C517	TDK	–	Chip Cap,1005 K 22nF
C518	TDK	–	Chip Cap, 1005 K 5.6nF
C519	TDK	–	Chip Cap, 1005 K 1.2nF
C520	TDK	–	Chip Cap, 1005 K 4.7nF
C521	TDK	–	Chip Cap, 1005 K 1.2nF
C522	TDK	–	Chip Cap, 1005 K 5.6nF
C523	TDK	–	Chip Cap,1005 K 1000PF
C524	TDK	–	Chip Cap,1005 K 33nF
C525	TDK	–	Chip Cap, 1005 K 330PF
C528	TDK	–	Chip Cap, 1005 K 18nF
C529	TDK	–	Chip Cap,1005 Z 0.1µF
C530	TDK	–	Chip Cap,1005 K 10nF
C531	TDK	–	Chip Cap,1005 Z 0.1µF
C533	TDK	–	Chip Cap,1005 Z 0.1µF
C536	TDK	–	Chip Cap,1005 K 10nF
C537	TDK	–	Chip Cap, 1005 K 2200PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C538	TDK	–	Chip Cap,1005 K 10nF
C539	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C540	TDK	–	Chip Cap, 1608 Z 0.1µF
C541	TDK	–	Chip Cap,1005 Z 0.1µF
C542	TDK	–	Chip Cap,1005 K 10nF
C543	TDK	–	Chip Cap, 1005 K 1.2nF
C545	HITACH	–	Chip Tantal, 22uF-M/ 10V(A)
C546	TDK	–	Chip Cap,1005 K 0.1µF
C549	TDK	–	Chip Cap,1005 K 560PF
C550	TDK	–	Chip Cap,1005 K 560PF
C560	TDK	–	Chip Cap,1005 J 47PF
C561	TDK	–	Chip Cap,1005 J 47PF
C562	TDK	–	Chip Cap,1005 J 47PF
C563	TDK	–	Chip Cap,1005 J 47PF
C564	TDK	–	Chip Cap,1005 J 47PF
C565	TDK	–	Chip Cap,1005 J 47PF
C566	TDK	–	Chip Cap,1005 J 47PF
C567	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C568	TDK	–	Chip Cap,1005 K 10nF
C570	TDK	–	Chip Cap, 1005 J 47PF
C601	HITACH	–	Chip Tantal, 10uF-M/ 16V(A)
C602	TDK	–	Chip Cap,1005 K 0.22µF
C605	TDK	–	Chip Cap, 2012 Z 4.7uF
C606	TDK	–	Chip Cap,1005 Z 0.1µF
C609	TDK	–	Chip Cap,1005 K 0.1µF
C615	TDK	–	Chip Cap, 1608 K 0.22µF
C616	TDK	–	Chip Cap,1005 K 0.1µF
C617	TDK	–	Chip Cap,1005 K 0.1µF

Circuit Ref.	Supplier	Supplier Part No.	Description
C618	HITACH	–	Chip Tantal, 4.7uF-M/ 16V(A)
C619	TDK	–	Chip Cap, 1005 J 33PF
C620	TDK	–	Chip Cap,1005 K 470PF
C621	TDK	–	Chip Cap,1005 K 470PF
C622	TDK	–	Chip Cap, 1005 J 47PF
C701	HITACH	–	Chip Tantal, 22uF-M/ 10V(A)
C702	TDK	–	Chip Cap,1005 K 1000PF
C704	TDK	–	Chip Cap,1005 K 470PF
C705	TDK	–	Chip Cap,1005 D 6PF
C706	TDK	–	Chip Cap, 1005 D 10PF
C707	TDK	–	Chip Cap, 1005 J 27PF
C709	TDK	–	Chip Cap, 1005 D 10PF
C710	MURATA	–	Chip Trimmer Cap, 2PIE 10PF
C711	TDK	–	Chip Cap, 1005 J 33PF
C712	TDK	–	Chip Cap,1005 K 470PF
C714	TDK	–	Chip Cap,1005 K 1000PF
C715	HITACH	–	Chip Tantal, 22uF-M/ 10V(A)
C716	TDK	–	Chip Cap,1005 K 470PF
C717	TDK	–	Chip Cap, 1005 J 12PF
C718	TDK	–	Chip Cap, 1005 J 12PF
C719	TDK	–	Chip Cap, 1005 J 27PF
C721	TDK	–	Chip Cap, 1005 J 12PF
C722	MURATA	–	Chip Trimmer Cap, 2PIE 10PF
C723	TDK	–	Chip Cap, 1005 C 3PF
C724	TDK	–	Chip Cap, 1005 J 56PF
C725	TDK	–	Chip Cap,1005 K 470PF
C726	TDK	–	Chip Cap, 1005 D 6PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C727	TDK	–	Chip Cap, 1005 C 3PF
C728	TDK	–	Chip Cap, 1005 D 10PF
C729	TDK	–	Chip Cap, 1005 C 3PF
C730	TDK	–	Chip Cap, 1005 C 4PF
C731	TDK	–	Chip Cap, 1005 C 4PF
C738.	TDK	–	Chip Cap, 1005 D 7PF
C739	TDK	–	Chip Cap,1005 K 1000PF
C740	TDK	–	Chip Cap,1005 Z 0.1µF
C741	TDK	–	Chip Cap,1005 Z 0.1µF
C746	TDK	–	Chip Cap, 1005 J 20PF
C747	TDK	–	Chip Cap, 1005 J 33PF
C748	TDK	–	Chip Cap,1005 Z 0.1µF
C749	TDK	–	Chip Cap, 1608 Z 1µF
C750	TDK	–	Chip Cap,1005 Z 0.1µF
C751	HITACH	–	Chip Tantal, 1uF-M/35V(A)
C752	TDK	–	Chip Cap,1005 K 0.1µF
C753	PANASONIC	–	Film Chip Cap, 3216 J 47nF
C754	PANASONIC	–	Film Chip Cap, 3216 J 47nF
C755	TDK	–	Chip Cap,1005 K 0.1µF
C756	TDK	–	Chip Cap,1005 K 1000PF
C1001	TDK	–	Chip Cap, 1005 J 47PF
C1002	TDK	–	Chip Cap, 1005 J 47PF
C1003	TDK	–	Chip Cap, 1005 J 47PF
C1004	TDK	–	Chip Cap, 1005 J 47PF
C1005	TDK	–	Chip Cap, 1005 J 47PF
C1006	TDK	–	Chip Cap, 1005 J 47PF
C1007	TDK	–	Chip Cap, 1005 J 47PF
C1008	TDK	–	Chip Cap, 1005 J 47PF
C1009	TDK	–	Chip Cap, 1005 J 47PF
C1010	TDK	–	Chip Cap, 1005 J 47PF
C1011	TDK	–	Chip Cap, 1005 J 47PF
C1012	TDK	–	Chip Cap, 1005 J 47PF
C1013	TDK	–	Chip Cap, 1005 J 47PF
C1014	TDK	–	Chip Cap, 1005 J 47PF
C1015	TDK	–	Chip Cap, 1005 J 47PF
C1018	TDK	–	Chip Cap, 1005 J 220PF
CF1	BGTech	8286045500120	TOKO, Ceramic Filter, ELFY455F
CF2	BGTech	8286045500220	TOKO, Ceramic Filter, ELFY455H
CR110	Bright LED	–	LED DIODE, BL-HG036D-TR
CR111	Bright LED	–	LED DIODE, BL-HG036D-TR
CR112[1]	Bright LED	–	LED DIODE, BL-HG036D-TR
CR113[1]	Bright LED	–	LED DIODE, BL-HG036D-TR
CR114[1]	Bright LED	–	LED DIODE, BL-HG036D-TR
CR115[1]	Bright LED	–	LED DIODE, BL-HG036D-TR
CR116	KEC	–	SWITCH DIODE, KDS-160E (ESM)
CR117	KEC	–	SWITCH DIODE, KDS-160E (ESM)
CR201	KEC	–	Switch DIODE, KDS 181
CR202	KEC	–	Switch DIODE, KDS 181
CR301	PANASONIC	–	Switch DIODE, MA2S07700L
CR302	KEC	–	VARIABLE DIODE, KDV269E
CR303	KEC	–	VARIABLE DIODE, KDV269E
CR305	KEC	–	VARIABLE DIODE, KDV269E
CR306	KEC	–	SWITCH DIODE, KDS-160E (ESM)
CR307	KEC	–	VARIABLE DIODE, KDV269E
CR312	KEC	–	SWITCH DIODE, KDS-160E (ESM)
CR315	KEC	–	SWITCH DIODE, KDS-160E (ESM)
CR401	M/A COM	–	PIN DIODE, MA4P7001F-1072T
CR501	BRIGHT LED	–	LED DIODE, BL-HEIG033B-TR
CR601	KEC	–	ZENOR DIODE, KDZ5.1V
CR701	KEC	–	VARIABLE DIODE, KDV300E
CR702	KEC	–	VARIABLE DIODE, KDV300E
CR703	KEC	–	VARIABLE DIODE, KDV300E
DEC1	BGTech	8287455c24010	CP, Desciminator, JTBC455C24
F-CABLE 1	BGTech	8560228005000	SNAGGWA, BEACON FLAT CABLE, FF12-22N080XXA
F-CABLE 2	BGTech	8560124005000	SNAGGWA, BEACON FLAT CABLE, FF12-12N040XXA
FL101	BGTech	82827R3728M00	SHINSUNG, Crystal, 7.3728MHz (H: 2.8mm)
FL102	BGTech	82827R5795M00	SHINSUNG, Crystal, 3.5795MHz (H: 2.8mm)
FL201	BGTech	828244R645M00	SHINSUNG, Crystal, 44.645MHz (SMD)
FL301	BGTech	828645R100220	SHINSUNG, Crystal, MCF 45.15S12.B (8.5KHz)

Circuit Ref.	Supplier	Supplier Part No.	Description
FL701	BGTech	8289012R80010	SHINSUNG, VCTCXO, 12.8 MHZ
J101	BGTech	851607C01S110	YUNHO, FPC CONNECTOR, 05004HR-07C01S(G)
J102	BGTech	851622A01S110	YUNHO, FPC CONNECTOR, 05004HR-22A01S
J103	BGTech	8516220005020	KYOCERA, FPC CONNECTOR, 04-6292-022-000-800+
J104	BGTech	851612151A110	OMIRON, FPC CONNECTOR, XF2M-1215-1A
J105	BGTech	851612A01S110	YUNHO, FPC CONNECTOR, 05004HR-12B01S(G)
J601	BGTech	8500031009800	CHI CHENG, SPK MIC JACK, 0980683Z01-D
J602	BGTech	85100G500PL00	SUYIN, BATTERY CONNECTOR, 060031MA005G500PL
J603	BGTech	8510530470210	MOLEX, CONNECTOR, 53047-0210
L301	TAIYOYUDEN	–	ChipInd,LEM2520T-68NK
L302	DELTA	–	Chip Ind, 2012 27nH
L303	DELTA	–	Chip Ind, 2012 12nH
L304	DELTA	–	Chip Ind, 2012 68nH
L305	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L306	DELTA	–	Chip Ind, 2012 820NH (Tolerance: 5%)
L307	DELTA	–	Chip Ind, 2012 12nH
L308	DELTA	–	Chip Ind, 2012 68nH
L309	DELTA	–	Chip Ind, 2012 22nH
L310	TAIYOYUDEN	–	Chip Ind, 1005 J 47N
L311	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L326	DELTA	–	Chip Ind, 2012 220nH
L327	TAIYOYUDEN	–	Chip Ind,1608 K 820NH
L329	BGTech	8920PT1667020	TOKO, #617PT-1667
L330	TAIYOYUDEN	–	Chip Ind, 1005 J 82N
L331	TAIYOYUDEN	–	Chip Ind, 1005 J 47N
L332	TAIYOYUDEN	–	Chip Ind,1608 K 820NH
L333	BGTech	8920PT1664020	TOKO, #617PT-1664
L335	TAIYOYUDEN	–	Chip Ind, 1005 J 27N
L336	TAIYOYUDEN	–	Chip Ind, 1005 J 27N
L337	TAIYOYUDEN	–	Chip Ind, 1005 J 22N
L340	TAIYOYUDEN	–	Chip Ind,1608 K 820NH
L401	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L403	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L404	TAIYOYUDEN	–	Chip Ind, 1005 J 22N
L405	TAIYOYUDEN	–	Chip Ind, 1005 J 22N
L406	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L407	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L408	DAERIM	–	COIL AIR, 0.28-1.1-6TL(SMD)
L409	DAERIM	–	COIL AIR, 0.35-1.6-6TL(SMD)
L410	DAERIM	–	COIL AIR, 0.35-1.6-6TL(SMD)
L411	DAERIM	–	COIL AIR, 0.35-1.6-6TL(SMD)
L412	TAIYOYUDEN	–	ChipInd,LK1608-1R0K-T
L413	DAERIM	–	COIL AIR, 0.35-1.6-7TL(SMD)
L415	DAERIM	–	COIL AIR, 0.45-1.4-3TL
L416	DAERIM	–	COIL AIR, 0.45-1.4-3TL
L601	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L602	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L603	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L604	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L701	TAIYOYUDEN	–	ChipInd,HK1005R10J
L702	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L703	DAERIM	–	COIL AIR, 0.28-1.1-6TL(SMD)
L704	TAIYOYUDEN	–	ChipInd,LK1608-1R0K-T
L705	TAIYOYUDEN	–	Chip Ind, 1608 K 2.2uH
L706	DAERIM	–	COILAIR,0.3-1.4-6TL
L707	TAIYOYUDEN	–	ChipInd,LK1608-1R0K-T
L708	TAIYOYUDEN	–	Chip Ind, 1608 220nH J
L709	TAIYOYUDEN	–	Chip Ind, 1005 J 47N
LCD1	BGTech	86343208A2020	EVERRVIEW,VBS3208A2-7FWLYA,REV4.0
MIC1	BGTech	8420063215000	BSE, C-MIC, 6.0*2.7/ 2.2KΩ,2V,-44±3dB, Pin type
PB501	BGTech	8466PUD02K020	PANASONIC, Tack Switch, EVQPUD02K
PB502	BGTech	8466PUD02K020	PANASONIC, Tack Switch, EVQPUD02K
PB503	BGTech	8466PUD02K020	PANASONIC, Tack Switch, EVQPUD02K
Q101	KEC	–	KRC413
Q102	KEC	–	KRC413
Q103	KEC	–	KRC413
Q104	KEC	–	KRC413
Q110	KEC	–	SWITCHING TR
Q111	KEC	–	KTA 2014
Q112	KEC	–	KTA 2014
Q113	KEC	–	KRC 404
Q114	KEC	–	KRC 404
Q120	KEC	–	KRC 404
Q121	KEC	–	KRC 404

Circuit Ref.	Supplier	Supplier Part No.	Description
Q122	KEC	–	KRC 404
Q201	KEC	–	KRC 404
Q202	KEC	–	KRC 404
Q206	KEC	–	KRC 404
Q207	KEC	–	KRC 404
Q301	NEC	–	SWITCHING TR
Q303	NEC	–	SWITCHING TR
Q304	KEC	–	KRA 305
Q305	KEC	–	KRC 404
Q306	BGTech	81492SK711020	2SK711 TOSHIBA FET N-Channel Transistor
Q307	BGTech	81492SK711020	2SK711 TOSHIBA FET N-Channel Transistor
Q401	BGTech	8142000951120	PBR 951LT1 PHILIPS BJT NPN Transistor
Q402	BGTech	8149003078021	2SK3078A TOSHIBA FET N-channel Transistor
Q403	BGTech	8149003476021	2SK3476 TOSHIBA FET N-channel Transistor
Q404	BGTech	8145001188021	STB 1188 AUK BJT NPN Transistor
Q405	KEC	–	KTC 4075 BJT NPN Transistor
Q406	KEC	–	KRC 404 BJT NPN Transistor
Q407	KEC	–	KRA 305
Q408	KEC	–	KRC 404 BJT NPN Transistor
Q501	KEC	–	KRC 404 BJT NPN Transistor
Q502	KEC	–	KRC 404 BJT NPN Transistor
Q503	KEC	–	KRC 404 BJT NPN Transistor
Q504	KEC	–	KRC 404 BJT NPN Transistor
Q505	KEC	–	KRA 305
Q601	KEC	–	KRC 404 BJT NPN Transistor
Q610	KEC	–	KRC 404 BJT NPN Transistor
Q7	NEC	–	2SC4226 BJT NPN Transistor
Q701	NEC	–	2SC4226 BJT NPN Transistor
Q702	NEC	–	2SC4226 BJT NPN Transistor
Q703	NEC	–	2SC4226 BJT NPN Transistor
Q704	NEC	–	2SC4226 BJT NPN Transistor
Q705	KEC	–	KRA 305 BJT PNP Transistor
Q706	KEC	–	KRA 305 BJT PNP Transistor
Q707	KEC	–	KTC 4075 BJT NPN Transistor
Q708	KEC	–	KTA 2014 BJT PNP Transistor
Q709	KEC	–	KTA 2014 BJT PNP Transistor
Q710	KEC	–	KTC 4075 BJT NPN Transistor
Q711	KEC	–	KRA304 BJT PNP Transistor
R101	KAMAYA	–	Chip Res, 1005 J 10KΩ
R102	KAMAYA	–	Chip Res, 1005 J 47KΩ
R103	KAMAYA	–	Chip Res, 1005 J 150KΩ
R104	KAMAYA	–	Chip Res, 1005 J 47KΩ
R105	KAMAYA	–	Chip Res, 1005 J 47KΩ
R106	KAMAYA	–	Chip Res, 1005 J 47KΩ
R107	KAMAYA	–	Chip Res, 1005 J 3.9KΩ
R108[1]	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R109[1]	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R110	KAMAYA	–	Chip Res, 1005 J 270KΩ
R112[1]	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R113	KAMAYA	–	Chip Res, 1005 J 47KΩ
R114	KAMAYA	–	Chip Res, 1005 J 10KΩ
R115	KAMAYA	–	Chip Res, 1005 J 10KΩ
R116	KAMAYA	–	Chip Res, 1005 J 1.2KΩ
R117	KAMAYA	–	Chip Res, 1005 J 8.2KΩ
R118	KAMAYA	–	Chip Res, 1005 J 47KΩ
R119[1]	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R120	KAMAYA	–	Chip Res, 1005 J 47KΩ
R121	KAMAYA	–	Chip Res, 1005 J 330KΩ
R122	KAMAYA	–	Chip Res, 1005 J 330KΩ
R126	KAMAYA	–	Chip Res, 1005 J 15KΩ
R127	KAMAYA	–	Chip Res, 1005 J 33KΩ
R128	KAMAYA	–	Chip Res, 1005 J 3.9KΩ
R129	KAMAYA	–	Chip Res, 1005 J 150KΩ
R131	KAMAYA	–	Chip Res, 1005 J 10Ω
R132	KAMAYA	–	Chip Res, 1005 J 10KΩ
R133	KAMAYA	–	Chip Res, 1005 J 470KΩ
R134	KAMAYA	–	Chip Res, 1005 J 4.7MΩ
R135	TDK	–	Chip Cap,1005 K 0.1µF
R136	KAMAYA	–	Chip Res, 1005 J 100KΩ
R137	KAMAYA	–	Chip Res, 1005 J 4.7MΩ
R138	KAMAYA	–	Chip Res, 1005 J 220KΩ
R139	KAMAYA	–	Chip Res, 1005 J 10KΩ
R140	KAMAYA	–	Chip Res, 1005 J 68KΩ

Circuit Ref.	Supplier	Supplier Part No.	Description
R141	KAMAYA	–	Chip Res, 1005 J 100KΩ
R142	KAMAYA	–	Chip Res, 1005 J 330KΩ
R143	KAMAYA	–	Chip Res, 1005 J 91KΩ
R144	KAMAYA	–	Chip Res, 1005 J 100KΩ
R145	KAMAYA	–	Chip Res, 1005 J 1MΩ
R146	KAMAYA	–	Chip Res, 1005 J 0Ω
R147	KAMAYA	–	Chip Res, 1005 J 47KΩ
R148	KAMAYA	–	Chip Res, 1005 J 1MΩ
R149	KAMAYA	–	Chip Res, 1005 J 100KΩ
R150	KAMAYA	–	Chip Res, 1005 F 10KΩ
R151	KAMAYA	–	Chip Res, 1005 F 12KΩ
R152	KAMAYA	–	Chip Res, 1005 J 680Ω
R153	KAMAYA	–	Chip Res, 1005 F 68KΩ
R154	KAMAYA	–	Chip Res, 1005 F 47KΩ
R155	KAMAYA	–	Chip Res, 1005 J 470Ω
R156	KAMAYA	–	Chip Res, 1005 J 1KΩ
R157[1]	KAMAYA	–	Chip Res, 1005 J 1KΩ
R158[1]	KAMAYA	–	Chip Res, 1005 J 1KΩ
R159	KAMAYA	–	Chip Res, 1005 J 47KΩ
R160	KAMAYA	–	Chip Res, 1005 J 47KΩ
R161	KAMAYA	–	Chip Res, 1005 J 47KΩ
R162	KAMAYA	–	Chip Res, 1005 J 820Ω
R163	KAMAYA	–	Chip Res, 1005 J 100KΩ
R164	KAMAYA	–	Chip Res, 1005 J 100KΩ
R165	KAMAYA	–	Chip Res, 1005 F 3KΩ
R167	KAMAYA	–	Chip Res, 1005 J 100KΩ
R168	KAMAYA	–	Chip Res, 1005 J 100KΩ
R169	KAMAYA	–	Chip Res, 1005 J 1.2KΩ
R171	KAMAYA	–	Chip Res, 1005 J 10KΩ
R172	KAMAYA	–	Chip Res, 1005 J 10KΩ
R173	KAMAYA	–	Chip Res, 1005 J 10KΩ
R174	KAMAYA	–	Chip Res, 1005 J 120KΩ
R175	KAMAYA	–	Chip Res, 1005 J 47KΩ
R176	KAMAYA	–	Chip Res, 1005 J 30KΩ
R177	KAMAYA	–	Chip Res, 1005 J 56KΩ
R178	KAMAYA	–	Chip Res, 1005 J 100KΩ
R179	KAMAYA	–	Chip Res, 1005 J 51KΩ
R180	KAMAYA	–	Chip Res, 1005 J 100KΩ
R181	KAMAYA	–	Chip Res, 1005 J 150Ω
R182	KAMAYA	–	Chip Res, 1005 J 200KΩ
R184	KAMAYA	–	Chip Res, 1005 J 15KΩ
R185	KAMAYA	–	Chip Res, 1005 J 0Ω
R190	KAMAYA	–	Chip Res, 1005 J 15KΩ
R191	KAMAYA	–	Chip Res, 1005 J 15KΩ
R192	KAMAYA	–	Chip Res, 1005 J 15KΩ
R193	KAMAYA	–	Chip Res, 1005 J 10KΩ
R194	KAMAYA	–	Chip Res, 1005 J 6.8KΩ
R195	KAMAYA	–	Chip Res, 1005 J 100Ω
R196	KAMAYA	–	Chip Res, 1005 J 47KΩ
R197	KAMAYA	–	Chip Res, 1005 J 47KΩ
R198	KAMAYA	–	Chip Res, 1005 J 47KΩ
R199	KAMAYA	–	Chip Res, 1005 J 47KΩ
R203	KAMAYA	–	Chip Res, 1005 J 22KΩ
R204	KAMAYA	–	Chip Res, 1005 J 22KΩ
R206	KAMAYA	–	Chip Res, 1005 J 10KΩ
R207	KAMAYA	–	Chip Res, 1005 J 22KΩ
R208	KAMAYA	–	Chip Res, 1005 J 2KΩ
R210	KAMAYA	–	Chip Res, 1005 J 120KΩ
R211	KAMAYA	–	Chip Res, 1005 J 15KΩ
R212	KAMAYA	–	Chip Res, 1005 J 100KΩ
R213	KAMAYA	–	Chip Res, 1005 J 20KΩ
R216	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R217	KAMAYA	–	Chip Res, 1005 J 10KΩ
R222	KAMAYA	–	Chip Res, 1005 J 1.2KΩ
R250	KAMAYA	–	Chip Res, 1005 J 10KΩ
R258	KAMAYA	–	Chip Res, 1005 J 1.5KΩ
R301	KAMAYA	–	Chip Res, 1005 J 100KΩ
R302	KAMAYA	–	Chip Res, 1005 J 100KΩ
R305	KAMAYA	–	Chip Res, 1005 J 39KΩ
R306	KAMAYA	–	Chip Res, 1005 J 100KΩ
R307	KAMAYA	–	Chip Res, 1005 J 100KΩ
R308	KAMAYA	–	Chip Res, 1005 J 150Ω
R309	KAMAYA	–	Chip Res, 1005 J 10Ω
R310	KAMAYA	–	1005 J 1KΩ
R311	KAMAYA	–	Chip Res, 1005 J 560Ω
R312	KAMAYA	–	Chip Res, 1005 J 220Ω
R314	KAMAYA	–	Chip Res, 1005 J 100Ω
R315	KAMAYA	–	Chip Res, 1005 J 100Ω
R316	KAMAYA	–	Chip Res, 1005 J 100KΩ
R317	KAMAYA	–	Chip Res, 1005 J 120KΩ
R318	KAMAYA	–	Chip Res, 1005 J 2.2KΩ
R319	KAMAYA	–	Chip Res, 1005 J 3.9KΩ
R336	KAMAYA	–	1005 J 1KΩ
R337	KAMAYA	–	Chip Res, 1005 J 10Ω
R338	KAMAYA	–	Chip Res, 1005 C 1PF
R342	KAMAYA	–	Chip Res, 1005 J 6.8KΩ
R357	KAMAYA	–	Chip Res, 1005 J 1Ω
R358	KAMAYA	–	Chip Res, 1005 J 1Ω
R399	KAMAYA	–	Chip Res, 1005 J 68Ω
R401	KAMAYA	–	Chip Res, 1005 J 180Ω

Circuit Ref.	Supplier	Supplier Part No.	Description
R402	KAMAYA	–	Chip Res, 1005 J 39Ω
R403	KAMAYA	–	Chip Res, 1005 J 180Ω
R404	KAMAYA	–	Chip Res, 1005 J 10KΩ
R405	KAMAYA	–	Chip Res, 1005 J 2.7KΩ
R406	KAMAYA	–	Chip Res, 1005 J 10Ω
R407	KAMAYA	–	Chip Res, 1005 J 8.2KΩ
R408	KAMAYA	–	Chip Res, 1005 J 2.2KΩ
R409	KAMAYA	–	Chip Res, 1005 J 10Ω
R410	KAMAYA	–	Chip Res, 1005 J 10Ω
R411	KAMAYA	–	Chip Res, 1005 J 3.3KΩ
R412	KAMAYA	–	Chip Res, 1005 J 3.9KΩ
R413	KAMAYA	–	Chip Res, 1005 J 8.2KΩ
R414	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R415	KAMAYA	–	Chip Res, 2012 J 220Ω
R416	KAMAYA	–	Chip Res, 1608 J 47KΩ
R417	ROHM	–	Chip Res, 1W J 2512 0.1Ω
R418	KAMAYA	–	Chip Res, 1608 D 220KΩ
R419	KAMAYA	–	Chip Res, 1608 D 220KΩ
R420	KAMAYA	–	Chip Res, 1005 J 4.7MΩ
R421	KAMAYA	–	Chip Res, 1608 D 68KΩ
R422	KAMAYA	–	Chip Res, 1608 D 68KΩ
R423	KAMAYA	–	Chip Res, 1005 J 3.9MΩ
R424	KAMAYA	–	Chip Res, 1005 J 12KΩ
R425	KAMAYA	–	Chip Res, 1005 J 2.4KΩ
R426	KAMAYA	–	Chip Res, 1005 J 3.9KΩ
R427	KAMAYA	–	Chip Res, 1005 J 47KΩ
R428	KAMAYA	–	Chip Res, 1005 J 100Ω
R429	KAMAYA	–	Chip Res, 1005 J 3.6KΩ
R430	KAMAYA	–	Chip Res, 1005 J 100Ω
R431	KAMAYA	–	Chip Res, 1005 J 47KΩ
R432	KAMAYA	–	Chip Res, 1005 J 47KΩ
R433	KAMAYA	–	Chip Res, 1005 J 0Ω
R434	KAMAYA	–	Chip Res, 1005 J 33KΩ
R435	KAMAYA	–	Chip Res, 1005 J 180Ω
R436	KAMAYA	–	Chip Res, 1005 J 47Ω
R499	KAMAYA	–	Chip Res, 1005 J 1.5KΩ
R501	KAMAYA	–	Chip Res, 1005 J 220Ω
R502	KAMAYA	–	Chip Res, 1005 J 220Ω
R503	KAMAYA	–	Chip Res, 1005 J 100KΩ
R504	NOBLE	–	CHIP SEMI V.R, 3PIE 47 KΩ
R505	KAMAYA	–	Chip Res, 1005 J 10KΩ
R506	KAMAYA	–	Chip Res, 1005 J 10KΩ
R507	KAMAYA	–	Chip Res, 1005 J 10KΩ
R508	KAMAYA	–	1005 J 1KΩ
R509	KAMAYA	–	Chip Res, 1005 J 2.2KΩ
R510	KAMAYA	–	Chip Res, 1005 J 15KΩ
R511	KAMAYA	–	Chip Res, 1005 J 8.2KΩ
R512	KAMAYA	–	Chip Res, 1005 J 20KΩ
R513	KAMAYA	–	Chip Res, 1005 J 10KΩ
R514	KAMAYA	–	Chip Res, 1005 J 24KΩ
R515	KAMAYA	–	Chip Res, 1005 J 12KΩ
R516	KAMAYA	–	Chip Res, 1005 J 12KΩ
R517	KAMAYA	–	Chip Res, 1005 J 15KΩ
R518	KAMAYA	–	Chip Res, 1005 J 5.6KΩ
R519	KAMAYA	–	Chip Res, 1005 J 2MΩ
R520	KAMAYA	–	Chip Res, 1005 J 560KΩ
R521	KAMAYA	–	Chip Res, 1005 J 330KΩ
R522	KAMAYA	–	Chip Res, 1005 J 30KΩ
R523	KAMAYA	–	Chip Res, 1005 F 30KΩ
R524	KAMAYA	–	Chip Res, 1005 F 47KΩ
R526	KAMAYA	–	Chip Res, 1005 J 100Ω
R527	KAMAYA	–	Chip Res, 1005 J 100KΩ
R528	KAMAYA	–	Chip Res, 1005 J 82KΩ
R529	KAMAYA	–	Chip Res, 1005 J 47KΩ
R530	KAMAYA	–	Chip Res, 1005 J 47KΩ
R531	KAMAYA	–	Chip Res, 1005 J 47KΩ
R532	KAMAYA	–	Chip Res, 1005 J 10KΩ
R533	KAMAYA	–	Chip Res, 1005 J 10KΩ
R534	KAMAYA	–	Chip Res, 1005 J 10KΩ
R535	KAMAYA	–	Chip Res, 1005 J 10KΩ
R536	KAMAYA	–	Chip Res, 1005 J 330KΩ
R537	KAMAYA	–	1005 J 1KΩ
R538	KAMAYA	–	Chip Res, 1005 J 8.2KΩ
R539	KAMAYA	–	Chip Res, 1005 J 330KΩ
R540	KAMAYA	–	Chip Res, 1005 J 47KΩ
R541	KAMAYA	–	Chip Res, 1005 J 330KΩ
R545	NOBLE	–	CHIP SEMI V.R, 2PIE 4.7 KΩ
R597	KAMAYA	–	Chip Res, 1005 J 4.7KΩ
R598	KAMAYA	–	Chip Res, 1005 J 20KΩ
R609	KAMAYA	–	Chip Res, 1005 J 1KΩ
R610	KAMAYA	–	Chip Res, 1005 J 2.2Ω
R613	KAMAYA	–	Chip Res, 1005 J 15KΩ
R614	KAMAYA	–	Chip Res, 1005 J 560KΩ
R615	KAMAYA	–	Chip Res, 1005 J 2.2Ω
R616	KAMAYA	–	Chip Res, 1005 J 0Ω
R619	KAMAYA	–	Chip Res, 1005 J 10KΩ
R620	KAMAYA	–	Chip Res, 1005 J 33KΩ
R621	KAMAYA	–	Chip Res, 1005 J 39KΩ
R635	KAMAYA	–	Chip Res, 1005 J 0Ω
R636	KAMAYA	–	Chip Res, 1005 J 560Ω

Circuit Ref.	Supplier	Supplier Part No.	Description
R701	KAMAYA	–	Chip Res, 1005 J 100Ω
R702	KAMAYA	–	Chip Res, 1005 F 3KΩ
R703	KAMAYA	–	Chip Res, 1005 F 10KΩ
R704	KAMAYA	–	Chip Res, 1005 F 10KΩ
R705	KAMAYA	–	Chip Res, 1005 J 180Ω
R706	KAMAYA	–	Chip Res, 1005 J 47Ω
R707	KAMAYA	–	Chip Res, 1005 F 4.7KΩ
R708	KAMAYA	–	Chip Res, 1005 F 12KΩ
R709	KAMAYA	–	Chip Res, 1005 F 12KΩ
R710	KAMAYA	–	Chip Res, 1005 J 180Ω
R711	KAMAYA	–	Chip Res, 1005 J 100KΩ
R712	KAMAYA	–	Chip Res, 1005 J 100KΩ
R713	KAMAYA	–	Chip Res, 1005 J 10KΩ
R714	KAMAYA	–	Chip Res, 1005 J 100Ω
R715	KAMAYA	–	Chip Res, 1005 J 100Ω
R716	KAMAYA	–	Chip Res, 1005 J 680Ω
R717	KAMAYA	–	Chip Res, 1005 J 56Ω
R718	KAMAYA	–	Chip Res, 1005 J 20KΩ
R719	KAMAYA	–	1005 J 1KΩ
R720	KAMAYA	–	Chip Res, 1005 J 270Ω
R721	KAMAYA	–	Chip Res, 1005 J 270Ω
R722	KAMAYA	–	Chip Res, 1005 J 22KΩ
R723	KAMAYA	–	Chip Res, 1005 J 1.2KΩ
R724	KAMAYA	–	Chip Res, 1005 J 820Ω
R725	KAMAYA	–	Chip Res, 1005 J 220Ω
R726	KAMAYA	–	Chip Res, 1005 J 2.4KΩ
R727	KAMAYA	–	Chip Res, 1005 J 2.7KΩ
R728	KAMAYA	–	Chip Res, 1005 J 2.7KΩ
R729	KAMAYA	–	Chip Res, 1005 J 100KΩ
R730	KAMAYA	–	Chip Res, 1005 J 33KΩ

Circuit Ref.	Supplier	Supplier Part No.	Description
R731	KAMAYA	–	Chip Res, 1005 J 10Ω
R732	KAMAYA	–	Chip Res, 1005 J 10KΩ
R733	KAMAYA	–	Chip Res, 1005 J 0Ω
R734	KAMAYA	–	Chip Res, 1005 J 10Ω
R740	KAMAYA	–	Chip Res, 1005 J 1.8KΩ
R751	KAMAYA	–	Chip Res, 1005 J 1KΩ
R752	KAMAYA	–	1005 J 1KΩ
R753	KAMAYA	–	1005 J 1KΩ
R1001	KAMAYA	–	Chip Res, 1005 J 10KΩ
R1002	KAMAYA	–	Chip Res, 1005 J 9.1KΩ
R1003	KAMAYA	–	Chip Res, 1005 J 10KΩ
R1004	KAMAYA	–	Chip Res, 1005 J 10KΩ
R1005	TDK	–	Chip Cap,1005 K 10nF
RT201	TAIYOYUDEN	–	Thermistor, 10K (TH)
RT501	TAIYOYUDEN	–	Thermistor, 10K (TH)
RT502	TAIYOYUDEN	–	Thermistor, 47K (TH)
SPK1	BG Tech	8400362424100	Speaker, 24Ω 1.0W 36θ (Connector type)
SW/ VOL1	BG Tech	84766N992N151	TOKOS, Switch Volume RY-8418
U101	BG Tech	81100303RF020	CPU IC
U102	BG Tech	8116AK2347020	AUDIO LSI, AK2347
U103	BG Tech	8192088L70020	DTMF RECEIVER, MT88L70
U104	BG Tech	811324LC64020	EEPROM IC, 24LC64
U105	BG Tech	8124000324011	OP AMP, NJM324
U106	BG Tech	8135TC7S66020	Analog SW IC, TC7S66FU
U107	BG Tech	81287027AT020	VOLTAGE DETECTOR, KIA7027AT
U201	BG Tech	8125311360020	FM IC, TA31136
U202	BG Tech	8191401150320	DIGITAL POTENTIOMETER, MCP4011-503E/MS

Circuit Ref.	Supplier	Supplier Part No.	Description
U401	BG Tech	8191401150220	DIGITAL POTENTIOMETER, MCP4011-502E/MS
U402	BG Tech	8124000358011	OP AMP (DUAL), KIA358
U501	BG Tech	8191401150220	DIGITAL POTENTIOMETER, MCP4011(5002)
U502	BG Tech	8124000324011	OP AMP, NJM324
U505	BG Tech	8124000324011	REGULAR IC, TK11250CMCL - G (AMTL)
U506	BG Tech	8123011250021	REGULATOR IC, TK11250AMTL
U507	BG Tech	8123011233020	VOLTAGE DOUBLER, TC1240AECH
U508	BG Tech	8128TC1240020	DIGITAL POTENTIOMETER, MCP4011-503E/MS
U601	BG Tech	811608541T020	AUDIO AMP (SOT 8PIN TYPE) IC, TDA8541T
U701	BG Tech	810415E03S020	PLL IC, MB15E03SLPFV1-G-BND-EF-6
PCB1	BG Tech	8431BEAVHF400	CAFSYSTEM, Main PCB, FR4 4 Layer PCB
SH101	BG Tech	8860BEACA1010	SHIELD CAN - VCO
SH102	BG Tech	8860BEAC93010	SHIELD CAN PLL
SH103	BG Tech	8660BEACA4010	PA SHIELD CAN
SH104	MOTOROLA	PMDN4137AR	Finger Strip PCB
SH105	MOTOROLA	PMDN4137AR	Finger Strip PCB
SH201	MOTOROLA	PMDN4151AR	Finger Strip–Pair
SUB PCB1	BGTech	8421BEACON100	CAFSYSTEM, Sub PCB, 1.2T 2 Layer
KEY PCB1	BGTech	8422BEACON100	CAFSYSTTEM, Key PCB, 1.2T 2Layer

Note:
1: Not for PMUD2441AAL

Notes

Chapter 11 403 – 447 MHz UHF1 Theory Of Operation

11.1 Introduction

This chapter provides a detailed theory of operation for the radio components. Schematic diagrams for the circuits described in the following paragraphs are located in Chapter 14 of this manual.

11.2 UHF1 Receiver

The UHF1 receiver design covers the frequency range of 403 – 447MHz and it is a double conversion super heterodyne with 1st IF 45.1MHz and 2nd IF 455kHz. The receiver is divided into two major blocks, Front End and Back End as shown in Figure 11-1.

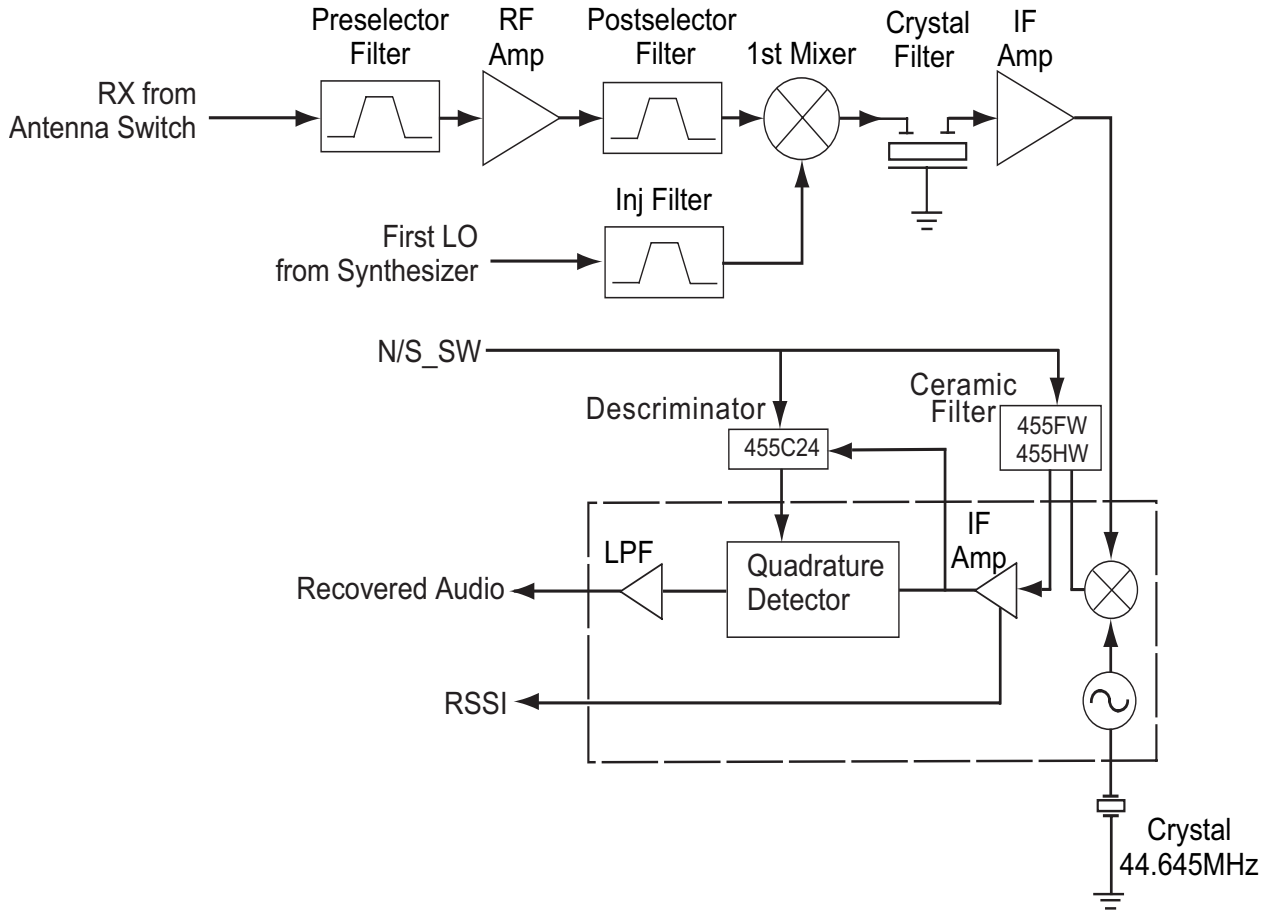


Figure 11-1. UHF1 Receiver Block Diagram

11.2.1 Receiver Front End

Incoming RF signals from antenna are first routed through the harmonic filter (L409 – L411, C426 – C429, C445, C446) and antenna switch (CR301), part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of preselector filter, RF amplifier, post-selector filter and a double-balanced mixer.

The preselector filter is a varactor-tuned 2-pole design using discrete elements (L320, L324, C351, C361, CR307 and CR314) in series/shunt resonator configuration. It is a band-shift filter and the frequency shift is controlled by varactor diodes CR307 and CR314, which are connected to the microprocessor. It is configured to provide steeper attenuation above the pass band for improved spurious rejection when high-side local injection is used. The frequency is separated into 8 steps and controlled by CPU (403 – 447MHz).

The output of this filter is matched to the base of RF amplifier Q301 which provides 13dB of gain. The output of the RF amplifier is applied to the post-selector filter. The post-selector filter designed using discrete elements (L323, L328, C379, C363 and C355) in a series/shunt resonator configuration. It is a band-shift filter and the frequency shift is controlled by varactor diodes CR305 and CR313, which are connected to the microprocessor. It is configured to provide steeper attenuation above the passband for improved spurious rejection when high-side local injection is used. The frequency is separated into 8 steps and controlled by CPU (403 – 447MHz).

The output of the post selector is connected to the double-balanced mixer consisting of components L329, L333, CR316. 1st local signal generated from VCO is filtered by injection filter (L310, L331, C325, C326, C388, C386, C365 and C387) to remove harmonics. The converted 1st IF frequency at mixer passes through L333 and matches the 45.1MHz IF signal to crystal filter (FL301).

11.2.2 Receiver Back End

The 1st IF signal is amplified about 15dB by IF amp Q303. The output of the IF amp is connected to IF IC (U201).

1st IF frequency (45.1MHz) and 2nd LO frequency (44.645MHz) are mixed in U201. The second mixer converts the 45.1MHz high IF frequency to 2nd IF frequency (455kHz).

Additional IF selectivity is provided by two ceramic filters (CF1, CF2). The wider filter 455FW is used for 25kHz channel spacing, and the narrower filter 455HW is used for 12.5kHz channel spacing. These two ceramic filters may eliminate undesired signal and demodulated by demodulator in U201. N/S_SW which connected to microprocessor is used to select the side and narrow band.

The mute (squelch) circuit switches off the audio amplifier when no audio is present. The squelch circuit consists of U201 and U202 and their associated components. The noise signal from Pin 9 of U201 is used to control the squelch circuit sensitivity of U202. The noise passes through filter, and is amplified by internal amp of U201. The amplified noise acts as a DC voltage to control the mute system. So if the noise level is under the threshold voltage, the microprocessor (U101) un-mutes the radio. If the noise level is over the threshold voltage, the microprocessor mutes the radio. The squelch level is tuned in the factory. When a component or a part in the RX system is replaced, the squelch must be re-tuned using the Tuner.

11.3 UHF1 Transmitter

The UHF1 transmitter covers the range of 403 – 447MHz. Depending on model, the output power of the transmitter is switchable on a per-channel basis between high power (4 Watt) and low power (1 Watt). The transmitter is divided into four major blocks as shown in Figure 11-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control.

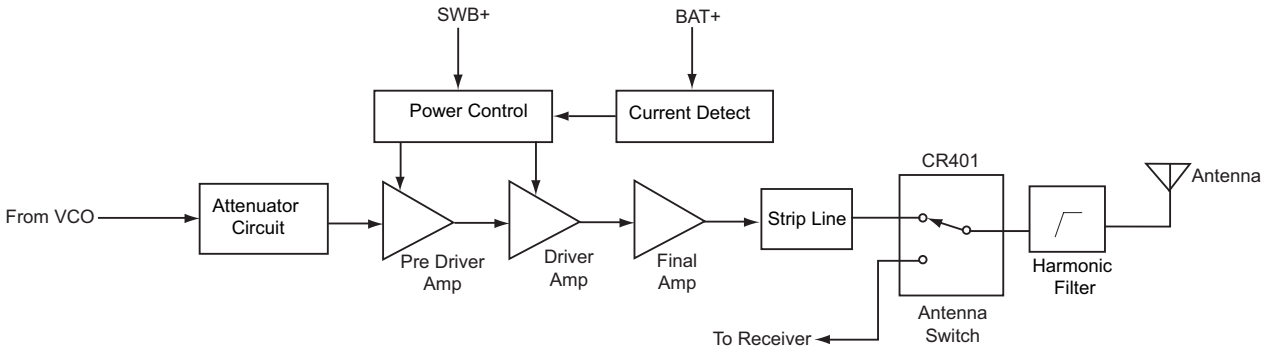


Figure 11-2. UHF1 Transmitter Block Diagram

11.3.1 Power Amplifier

The transmitter power amplifier has three stages of amplification – Pre Driver (Q401), Driver Amp (Q402) and Final Amp (Q403). Signal from TX VCO is applied to the pre driver via an attenuator circuit. The attenuator is pie style resistor attenuator, and is used as isolation between VCO and the power amps. The -4dBm TX RF signal from attenuator is then amplified by pre driver and driver amp to around +25dBm and is applied to the final amp. The final amp (Q403) is an enhancement-mode N-channel MOSFET device providing a gain of 12dB. The device drain current is drawn directly from the DC battery supply voltage input via L413. A matching network consisting of C416, C417, C418, C419, C420, C451, C422, C452 and a strip line, transforms the impedance to approximately 50Ohm.

11.3.2 Antenna Switch

An antenna switch works mainly as a switching device between transmit and receive paths. In transmit mode (PTT), Q407 is turned on and both PIN diodes (CR401, CR301) are forward biased into conduction. This enables the RF signal to pass to the harmonic filter and then to the antenna. In the receiver mode, both diodes are off. Signals applied to the antenna jack are routed via the LPF (harmonic filter), through network L409, L410, L411, C426, C427, C428, C429, C430, C445, C446 to the receiver input.

11.3.3 Harmonic Filter

The harmonic filter consists of components L409, L410, L411, C426, C427, C428, C429, C430, C445 and C446. The harmonic filter is a seven-pole Chebychev filter.

11.3.4 Auto Power Control

The APC keeps the current supply constant to the final amp (Q403). The drain current of Q403 (final amp) is sensed across resistor R417. The differential signal at the output of U401 (Pin 7) is passed to Q404 and Q405 that produces a constant power output to the antenna. If the current is changed due to change of battery voltage or load, APC controls gate voltage of Q403 and collector voltage of Q401 and drain voltage of Q402 to keep TX power stable. This circuit stabilizes TX power at a pre-determined level adjusted by U402. This bias voltage is tuned in the factory. If the transistor (Q403) is replaced, the RF Output Power must be tuned. By tuning the RF output power, the bias voltage will be tuned through U402. Extra care has to be taken during the tuning process. Do not exceed the maximum allowed bias voltage.

11.4 UHF1 Frequency Generation Circuitry

The PLL synthesizer subsystem consists of the reference oscillator (VCTCXO), VCO, PLLIC, Charge pump and Loop Filter.

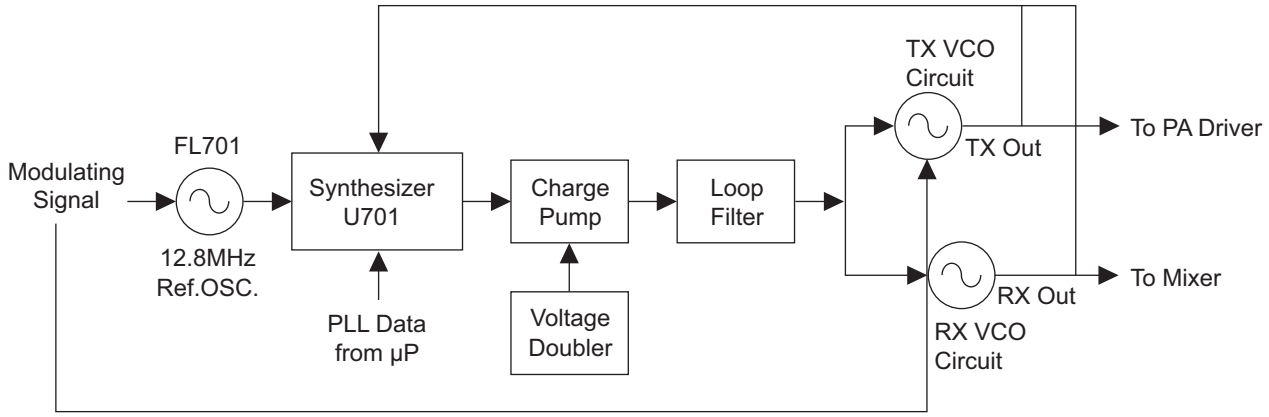


Figure 11-3. UHF1 Frequency Generation Unit Block Diagram

11.4.1 Reference Oscillator (12.8 MHz VCTCXO)

The reference oscillator is powered by regulated 5V provided by U505. The reference frequency 12.8MHz VCTCXO (Voltage Controlled Temperature Compensated Crystal Oscillator) is applied to the PLL IC (U701) via Pin 1. Min frequency can be adjusted by chip trimmer of VCTCXO. This frequency provides reference to the PLL IC and has a frequency stability of +/-2.5PPM (max) at the temperature ranging from -30 to +60 Degree Celsius.

11.4.2 PLL IC Prescaler and Comparator

The reference frequency from VCTCXO is divided to 6.25kHz or 5kHz by reference counter, R. The RF signal input from the VCO is divided to by prescaler (1/64), divided by N and A counters in PLL IC to determine frequency steps and then supplied to the comparator. The comparison frequency is 6.25/5kHz. The internal phase comparator compares the phase difference between the reference and VCO signal. When the phase of the reference frequency is leading, Pin 15(R) is the output. When VCO frequency is leading, Pin 16 (P) is the output. When P=R, small pulses are the output of the phase detector.

11.4.3 Voltage Doubler and Charge Pump

The voltage doubler (U507) converts 5V to 10V and is applied to the charge pump circuitry. The charge pump is used for charging output signals P, R supplied by PLL IC from 0-3.3v to 0-10v. This voltage is used to drive the VCO.

11.4.4 Loop Filter

The loop filter contains C751 – C754, R726 – R728. It reduces the residual side-band noise to get the best signal-to noise ratio. The output signal from loop filter is applied to VCO.

11.4.5 Dual VCO

The dual VCO module contains a RX VCO and a TX VCO. They are configured as colpitts oscillators and connected to power up through transistor switches. Only one VCO is selected at a time. A steering line voltage between 0.35V and 9.7V at varactor CR701 tunes the fill RX frequency range from 357.9MHz to 401.9MHz and varactor CR703 tunes the full TX frequency range from 403MHz to 447MHz.

In Receiver mode, high signal of RX_EN from Pin 71, U101 activates Q305. When Q305 is activated, current flows through the base of Q304 and thus activates the Q705. The varactor CR701 sets the resonance frequency. When there is a change in voltage supplied by loop filter, there is a change in the resonance frequency. L703 is the resonating coil, which forms the tank circuit together with variable cap C710.

In Transmit mode, high signal of TX_EN1 from Pin 84, U101 enables current flows through collector of Q503 and thus activates Q706. The varactor CR703 sets the resonance frequency. When there is a change in voltage supplied by loop filter, there is a change in the resonance frequency. L706 is the resonating tuning coil, which forms the tank circuit together with variable cap C722.

11.5 Keypad

Left, Right and P1 to P3 keys are directly connected to microprocessor via 22 Pin connector. When any of these keys is pressed, the voltage goes “low” and microprocessor detects it.

For full keypad models, the number keys are in matrix type which consisted of 3 rows and 4 columns. When any of these keys is pressed, the voltage goes “low” and microprocessor interprets the voltage for each key press.

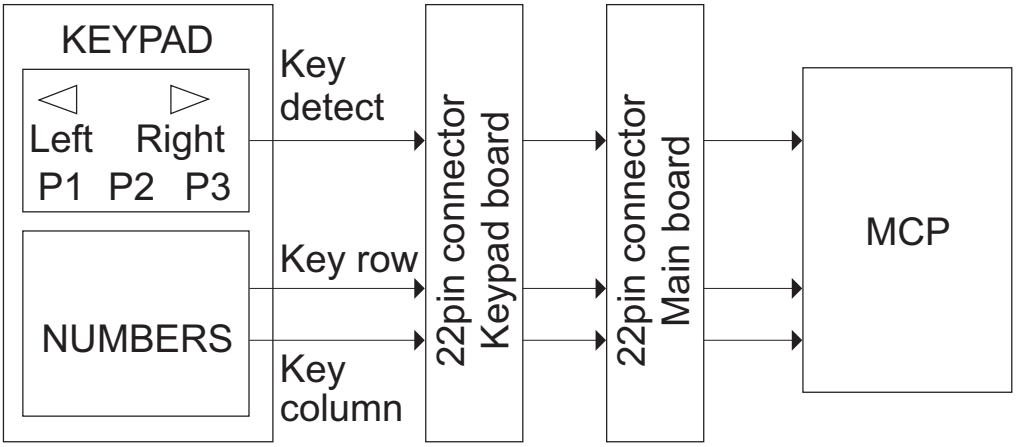


Figure 11-4. Keypad Block Diagram

Chapter 12 UHF1 Troubleshooting Tables

12.1 Troubleshooting Table for Receiver (UHF1)

Table 12-1. Troubleshooting Table for Receiver (UHF1)

Symptom	Possible Causes	Procedure	Corrective Action
Radio Dead (no turn–on beep, no LED indication)	1. Battery dead or defective	Substitute good battery or battery eliminator	Change or replace battery.
	2. Defective battery contacts	Inspect battery contacts for corrosion or bent terminals	Clean/Repair/Replace J602
	3. Microprocessor not starting up	Verify clock input to U101 Pin 13 is 7.3728 MHz using high impedance probe. Verify U101 Pin10(reset) is high.	Troubleshoot/Replace FL101. If reset is Low, troubleshoot regulator U506 or U107.
	4. Regulator fault	Verify U506 Pin 4 is 3.3V Verify U505 Pin 4 is 5.0V	Check for shorts on outputs Troubleshoot/Repair as needed, replace faulty regulator
	5. Flexible Cable fault	Check connection of the 12 pin flexible cable between J104 & J105	Re–assemble or replace flexible cable
No RX Audio (with LED indication)	1. Speaker dead or defective	Substitute a good housing (with speaker) Verify J603 connection	Change the housing (with accessory) Change the housing (with accessory)
	2. Audio Processor IC not starting up	Verify clock input U102 Pin 14 is 3.5795 MHz using high impedance probe.	Troubleshoot/Replace FL102
	3. Audio Amp IC not starting up	Verify U601 Pin 6 is battery voltage. If battery voltage is being supplied to Pin 6, then verify audio output at Pin 5 & 8.	Troubleshoot/Replace U601
No Receive (with no LED indication)	1. IF IC dead or fault	Verify clock input to U201 Pin 1 & 2 is 44.645Mhz using high impedance probe.	Troubleshoot/Replace FL201
No RX	1. RX–B+	Verify Q304's collector voltage is 4.8V when RX–EN is high.	Check/Replace Q304

12.2 Troubleshooting Table for Synthesizer (UHF1)

Table 12-2. Troubleshooting Table for Synthesizer (UHF1)

Symptom	Possible Causes	Procedure	Corrective Action
Synthesizer Out of Lock (No RX Mode)	1. Defective 12.8 MHz VCTCXO	Verify clock output FL701 Pin 3 is 12.8 MHz using high impedance probe.	Repair/Replace FL701
	2. 1/2VCC defective	Verify FL701 Pin 1, U502–B Pin 5 & U502–D Pin 14 voltage is 1.9V.	Troubleshoot: 1/2VCC circuitry
	3. No RX–Enable	Verify U101 Pin 71 (RX–EN1) is high. Verify Q304 collector voltage is approximately 4.7V in RX mode	Check U101 operating Troubleshoot: Q304 & Q305 circuitry
	4. Check PLL–LD port	Verify U101 Pin 27 is Low (Normal Mode) Verify U101 Pin 27 is swept from low to high (Power Save Mode)	Troubleshoot: PLL circuitry. Repair/Replace U701
Synthesizer Out of Lock (No TX Mode)	1. Defective 12.8 MHz VCTCXO	Verify clock output FL701 Pin 3 is 12.8 MHz using high impedance probe.	Repair/Replace FL701
	2. 1/2VCC defective	Verify FL701 Pin 1, U502–B Pin 5 & U502–D Pin 14 voltage is 1.9V.	Troubleshoot: 1/2VCC circuitry
	3. No TX–Enable	Verify U101 Pin 84(TX–EN1) is high when PTT is pressed. Verify Q407 collector voltage is approximately 4.7V when PTT is pressed (TX–EN2).	Check U101 operating Check U101–Pin 85 is high/ Replace Q407/check LK2 is short
	4. Check PLL–LD port	Verify U101 Pin 27 is Low (Normal Mode) Verify U101 Pin 27 is swept from low to high (Power Save Mode)	Troubleshoot: PLL circuitry Repair/Replace U701

12.3 Troubleshooting Table for Transmitter (UHF1)

Table 12-3. Troubleshooting Table for Transmitter (UHF1)

Symptom	Possible Causes	Procedure	Corrective Action
No internal Mic audio	1. Mic dead or defective	Verify audio present (~10mV rms) when speaking into Mic. Check bias of R194 (3.3V).	Replace Mic.
	2. Mic bias fault	Verify U101 Pin 78 is 1.1V when PTT button is pressed.	Check/Replace U101
	3. Audio Processor IC not starting up	Verify clock input U102 Pin 14 is 3.5795 MHz using high impedance probe.	Troubleshoot/Replace FL102
No EXT. Mic audio	1. J601 defective	Check connection with EXT mic	Check/Replace J601
	2. Audio Processor IC not starting up	Verify clock input U102 Pin 14 is 3.579545 MHz using high impedance probe.	Troubleshoot/Replace FL102
No transmit (No TX LED indication)	1.PTT switch defective	Verify U101 Pin 44 is low when PTT is pressed.	Replace PTT switch PB501
No transmit (TX LED indication OK)	1. Synthesizer out of lock	Refer to Table 12-2.	Check U101 operating
	2. No TX–Enable	Verify U101 Pin 84 (TX–EN1) is high when PTT is pressed. Verify Q407 collector voltage is approximately 4.7V when PTT is pressed (TX–EN2).	Check U101 Pin 85 is high/ Replace Q407/Check LK2 is short
Low Power	1. Low TX injection	Check the RF level at Q409 & C449 per schematic.	Troubleshoot Q409 circuitry & VCO bias
	2. R417 defective	Verify resistance is 0.1 Ohm	Replace R417.
	3. Incorrect control voltage	Verify Q404 collector voltage is approximately 5.5V in low frequency & high power.	Troubleshoot APC circuitry Replace Q404
	4. Q403 defective (High current)	Verify U401 Pin 7 is near 0V	Replace Q403
	5. Antenna switch defect	Verify CR401 anode voltage is approximately 1.4V	Check/replace CR401 & CR301
	6. Harmonic filter defective	Visually inspect components C426 – C429, C445, C446, C430	Repair/Replace if necessary
	7. Incorrect power tuning (this has to be performed only after item 1-6 has been checked)	Check conducted power	Re-tune power using tuner.
Poor TX range (Conducted power OK)	1. Defective or wrong Antenna.	Verify correct antenna is installed. Try using another antenna.	Replace antenna

12.4 Troubleshooting Table for Board and IC Signals (UHF1)

Table 12-4. Troubleshooting Table for Board and IC Signals (UHF1)

IC Designator	Pin	Pin Function	DC Voltage (V)	Comments (Condition)
U201(IF IC)	1	Osc1	3.9	44.645 MHz input
	2	Osc2	3.3	
	4	VCC	4.7	
	9	Audio frequency	1.2	
	12	RSSI out	Approximately 1	At –47dBm(with conducted)
	13	N–DET(BUSY)	Low	At busy
	15	GND	0	
	16	RF input	1	45.1 MHz input
U701(PLL IC)	1	Reference OSC input	1.4	12.8 MHz input
	4	VCC	3.3	
	6	GND	0	
	7	XF IN	2.2	
	8	F IN	2.2	
	12	Power save	High	
	13	GND	0	
	14	LD_out	High	If pll unlock is low
	15	@P	2.4	
	16	@R	Low	
U601	1	Mode (Mute con)	0	
(Audio Amp.)	2	SVR	3.8	
	3	IN+	3.8	
	4	IN-	3.8	
	5	OUT-	3.8	
	6	VCC	7.5	This voltage depends on Battery
	7	GND	0	
	8	OUT+	3.8	
U103	1	IN+	1.6	

Table 12-4. Troubleshooting Table for Board and IC Signals (UHF1) (Continued)

IC Designator	Pin	Pin Function	DC Voltage (V)	Comments (Condition)
(DTMF decoder)	2	IN-	1.6	
	3	GS	1.6	
	4	Vref	1.6	
	8	OSC1	1.6	3.579545 MHz input
	10	VSS	0	
	11	TOE	3.3	
	17	STD	High	At DTMF detecting
	18	EST	3.3	
	19	ST/GT	3.3	
	20	VDD	3.3	
FL701(VCTCXO)	1	VCON	1.9	
	2	GND	0	
	3	OSC out	osc	Generate the 12.8 MHz
	4	VCC	5	
Q206(N/S SW)	E	GND	0	
	B	N/S SW	12.5 kHz: Low	
	C	Collector	12.5 kHz: High 25 kHz: Low	
Q304	E	+5V	5	At RX Mode
	B	To Q305 collector	Low	
	C	RX_B+	4.7	
Q305	E	GND	0	At RX Mode
	B	RX_EN	High	
	C	To Q304 base	Low	
Q503	E	GND	0	At TX Mode
	B	TX_EN1	High	
	C	To Q706 base	Low	
Q407	E	+5V	5	At TX Mode
	B	To Q408 collector	Low	
	C	TXVB	4.7	
Q408	E	GND	0	At TX Mode
	B	TX_EN2	High	
	C	To Q407	Low	

Table 12-4. Troubleshooting Table for Board and IC Signals (UHF1) (Continued)

IC Designator	Pin	Pin Function	DC Voltage (V)	Comments (Condition)
Q601	E	GND	0	
	B	Audio_MUTE_CON	Mute: Low	
			None Mute: High	
	C	Mode	Mute: High	
			None Mute: Low	

1. All voltages are measured with a high-impedance digital voltmeter and expressed in volts DC relative to ground (0V).
2. Voltages are measured with a DC input voltage of 7.50 + .02 volts DC applied to the battery connector (J602).
3. All voltages are measured in the squelched receive mode, unless otherwise indicated.
4. Voltages are identical for VHF and UHF models unless otherwise indicated.

Chapter 13 UHF1 Schematic Diagrams, Overlays, and Parts Lists

13.1 Introduction

This section provides schematic diagrams, overlays, and parts lists for the radio circuit boards and interface connections.

13.1.1 Notes For All Schematics and Circuit Boards

* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

1. Unless otherwise stated, resistance values are in Ohms (K = 1000), capacitance values are in nanofarads (nF), picofarads (pF) or microfarads (µF), and inductance values are in nanohenries (nH) or microhenries (µH).
2. DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. If the board has been removed from the chassis, the transmitter module mounting screws may be used for ground connection. (*Note: The antenna nut bracket is connected to ground.*) Operating mode dependent voltages are followed by (RX) for receive mode, (TX) for transmit mode, (UNSQ) for unsquelched mode, etc.
3. RF voltages on VHF models are measured with a Fluke model 85 RF probe. The indicated voltages expressed in mV (RF) are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 1mV (-47dBm) RF signal applied to the antenna jack ANT1/ANT.
4. RF voltages on UHF models are measured both with a high–impedance RF voltmeter having a bandwidth in excess of 500 MHz (levels are expressed in dBm) and with a Fluke model 85 RF probe [levels are expressed in mV (RF)]. These indicated voltages are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms, and are only approximate for UHF frequency measurements. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 1mV (-47dBm) RF signal applied to the antenna jack ANT1/ANT.
5. Audio voltages are measured with a high-impedance AC rms voltmeter. The indicated voltages are expressed in mV rms. Receive mode voltages are followed by (RX) and are measured with an on-channel signal with 1 kHz modulation at 60% deviation (3 kHz for 25 kHz channels, or 1.5 kHz for 12.5 kHz channels). Transmit mode voltages are followed by (TX) and are measured with a 1 kHz, 10 mV rms signal present at the external microphone input (accessory connector J601).

6. Reference Designators are assigned in the following manner:

Ref. No. Series	Circuit Block
101 – 199	Microprocessor & audio control circuits
1001 – 1099	Microprocessor & audio control circuits
201 – 299	IF IC circuit
301 – 399	Front-end and 1st Mixer
401– 499	Transmit RF stage & Auto power control
501 – 599	Base band & generating circuit
601– 699	Audio amplifier
701– 799	VCO & PLL Synthesizer

7. Circuit Block Interconnection Legend:

Name	Description
+5V	5 Volts (Regulated)
+3.3V	3.3 Volts (Regulated)
SWB+	Switched Battery Voltage
BAT+	Unswitched Battery voltage
+10V	Digital 10V(Regulated)
RESET	Low-line reset signal fromU107 to U101 Pin 10
TX_EN1	Transmit enable signal from U101 Pin 84
TX_EN2	Transmit enable signal from U101 Pin 85
TXVB	TX operating voltage
TX_AF3	TX audio signal from audio processor IC to TX Audio filter
TX_SUB_TONE	TX sub tone signal from audio processor IC to TX modulation.
RX_B+	RX operating voltage
RSSI	RX signal strength indication from IF IC to U101
Busy	RX detect signal from IF IC to U101
FTV	RX frequency shift voltage
RX_AF1	RX audio signal from IF IC to Audio processor IC
PLL_LD	PLL lock detect signal from PLL IC to U101
N/S SW	Channel space selectable Switch (12.5 kHz/25 kHz)
1/2VCC	1.9 volts (divided by U502-D)

13.1.2 Four Layer Circuit Board

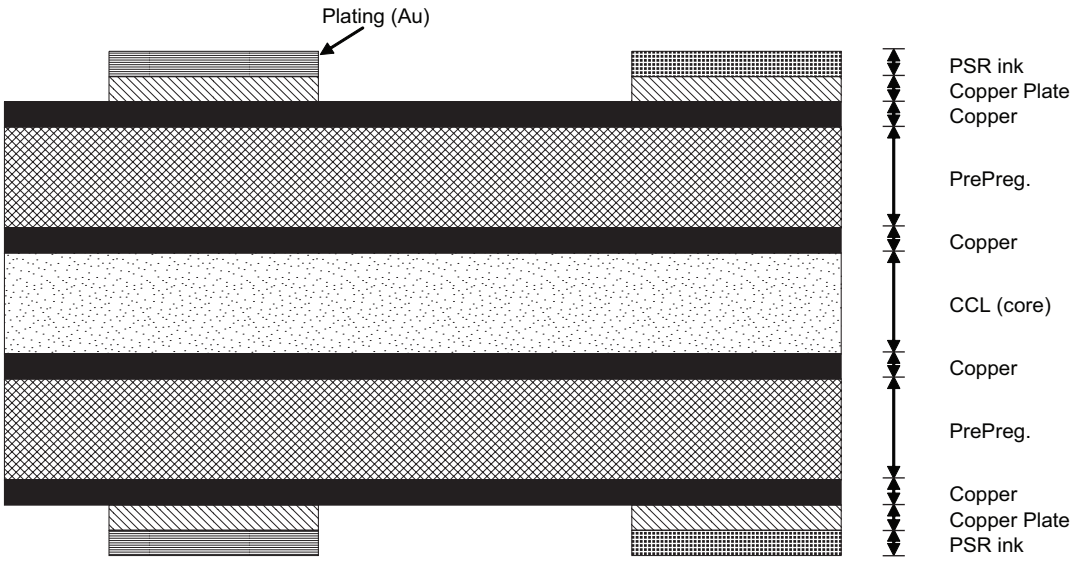


Figure 13-1. Four–Layer Circuit Board: Copper Steps in Layer Sequence

13.2 Speaker and Microphone Schematic

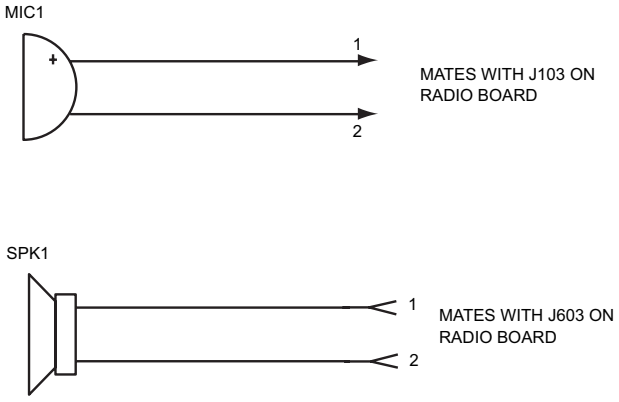


Figure 13-2. Speaker and Microphone Schematic

13.2.1 Speaker and Microphone Parts List

Reference Designator	Motorola Part No.	Description
MIC1	PMDN4139_R	Microphone
SPK1	PMDN4067BR	Speaker & Cable

13.3 Circuit Board/Schematic Diagram and Parts List (UHF1: 403–447 MHz)

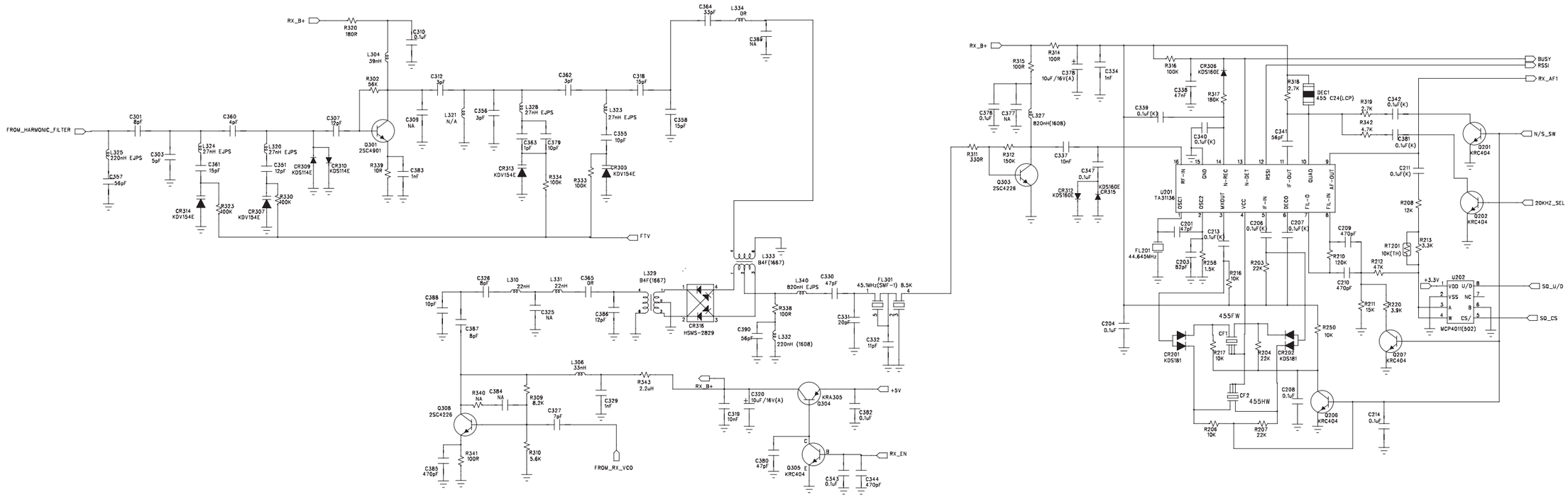


Figure 13-3. UHF1 (403–447 MHz) Receiver Schematic Diagram

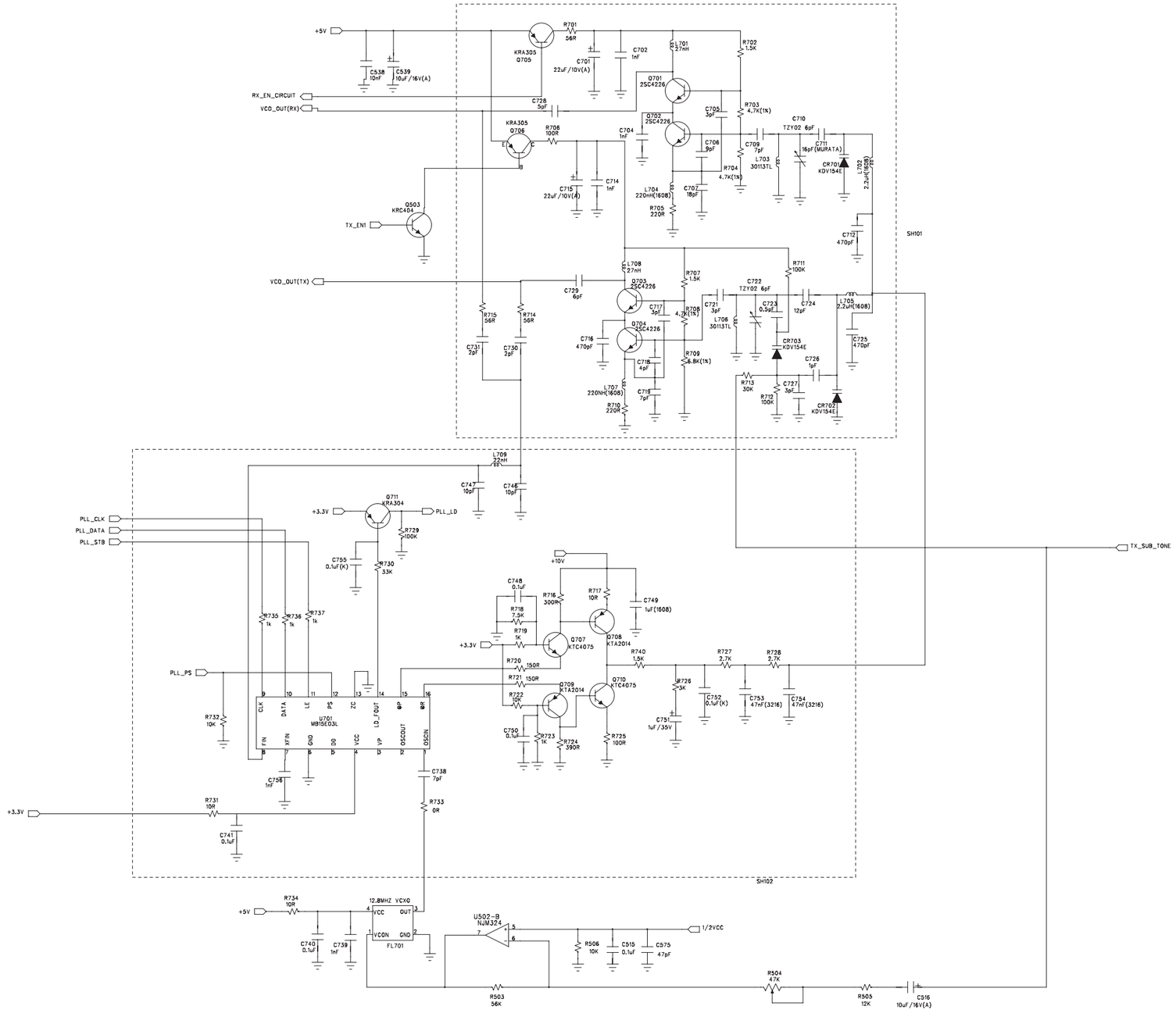


Figure 13-4. VCO and PLL Schematic Diagram

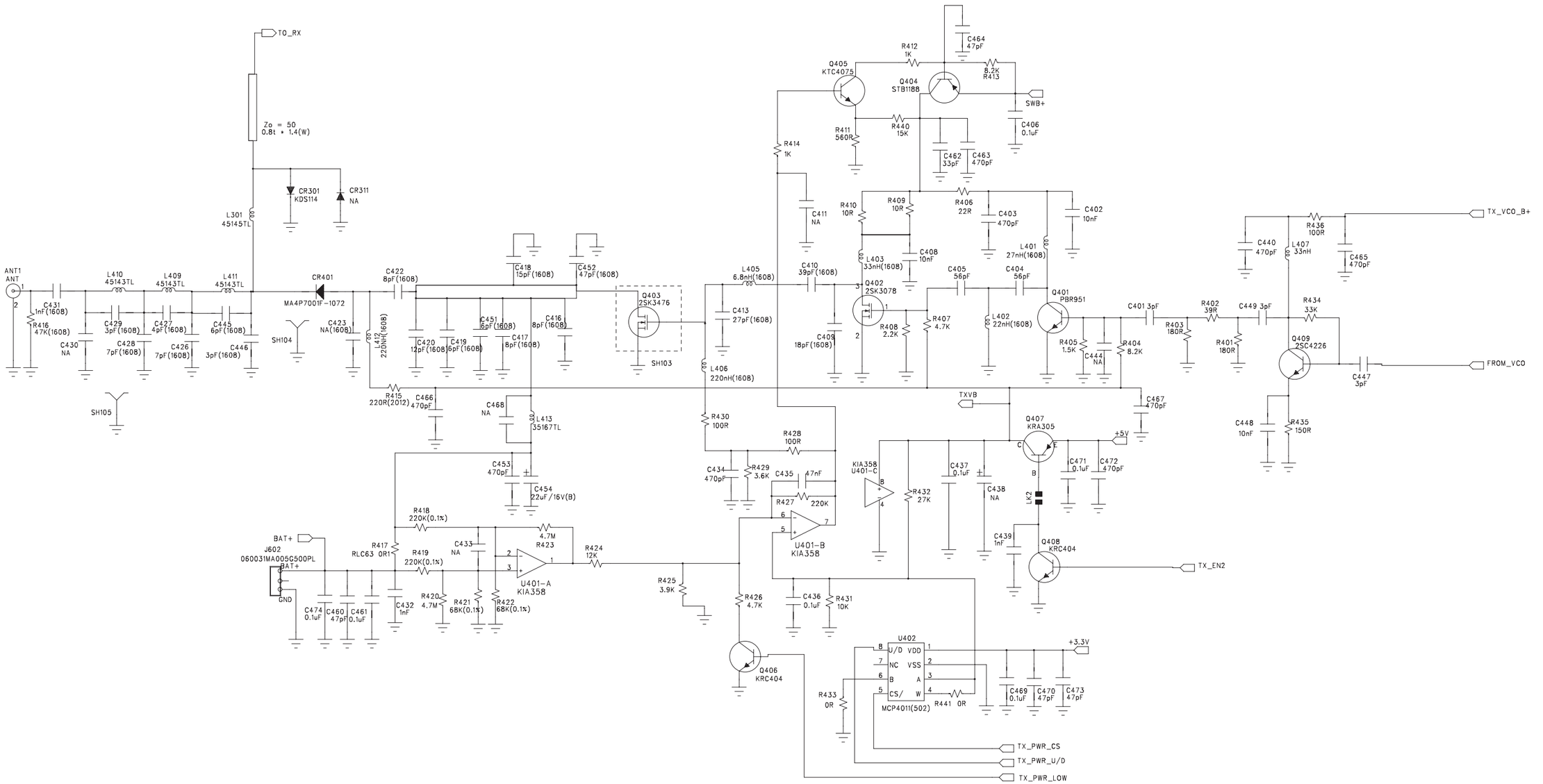


Figure 13-5. Transmitter Schematic Diagram

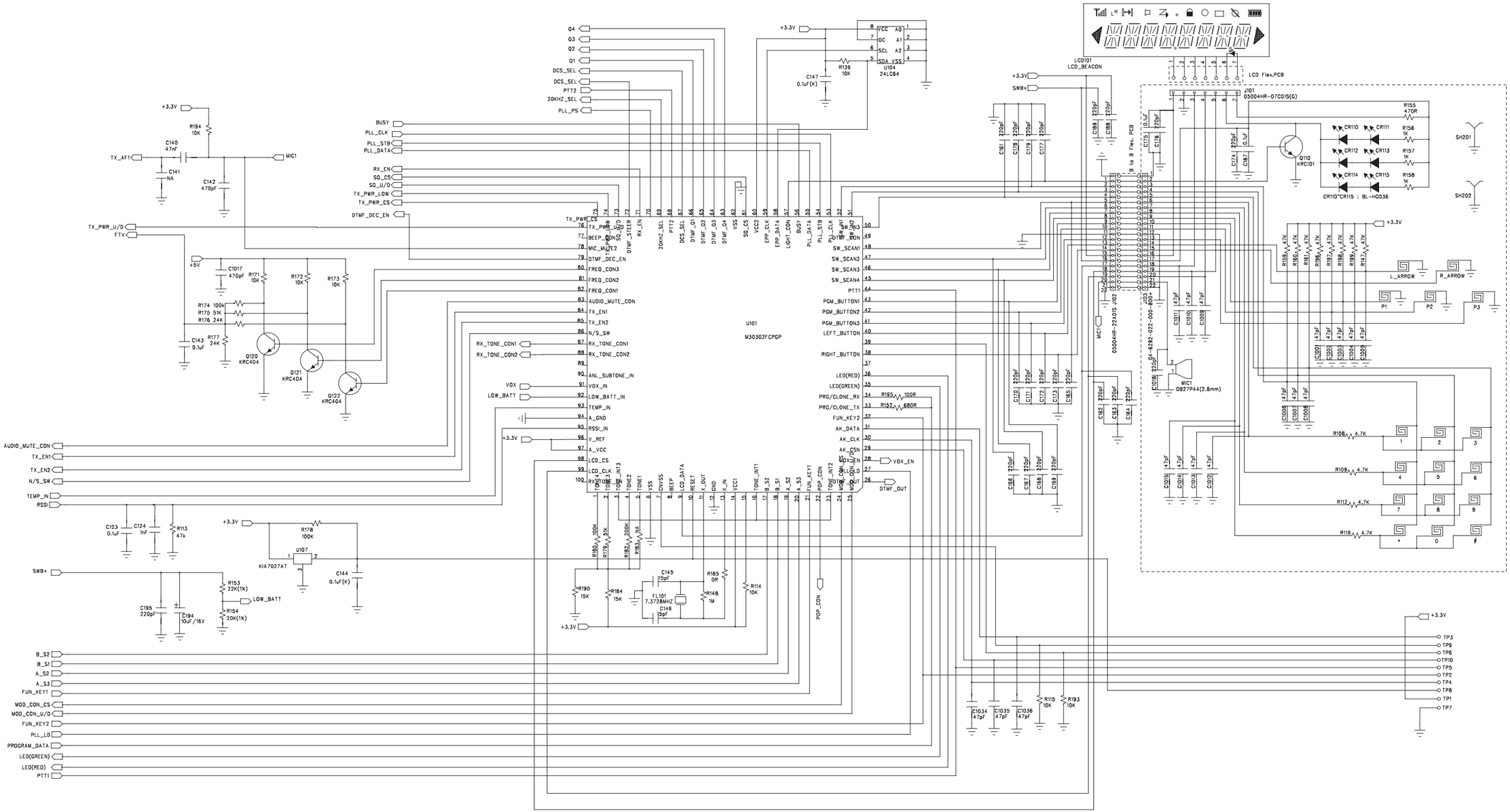


Figure 13-6. Microprocessor and Keypad Schematic Diagram

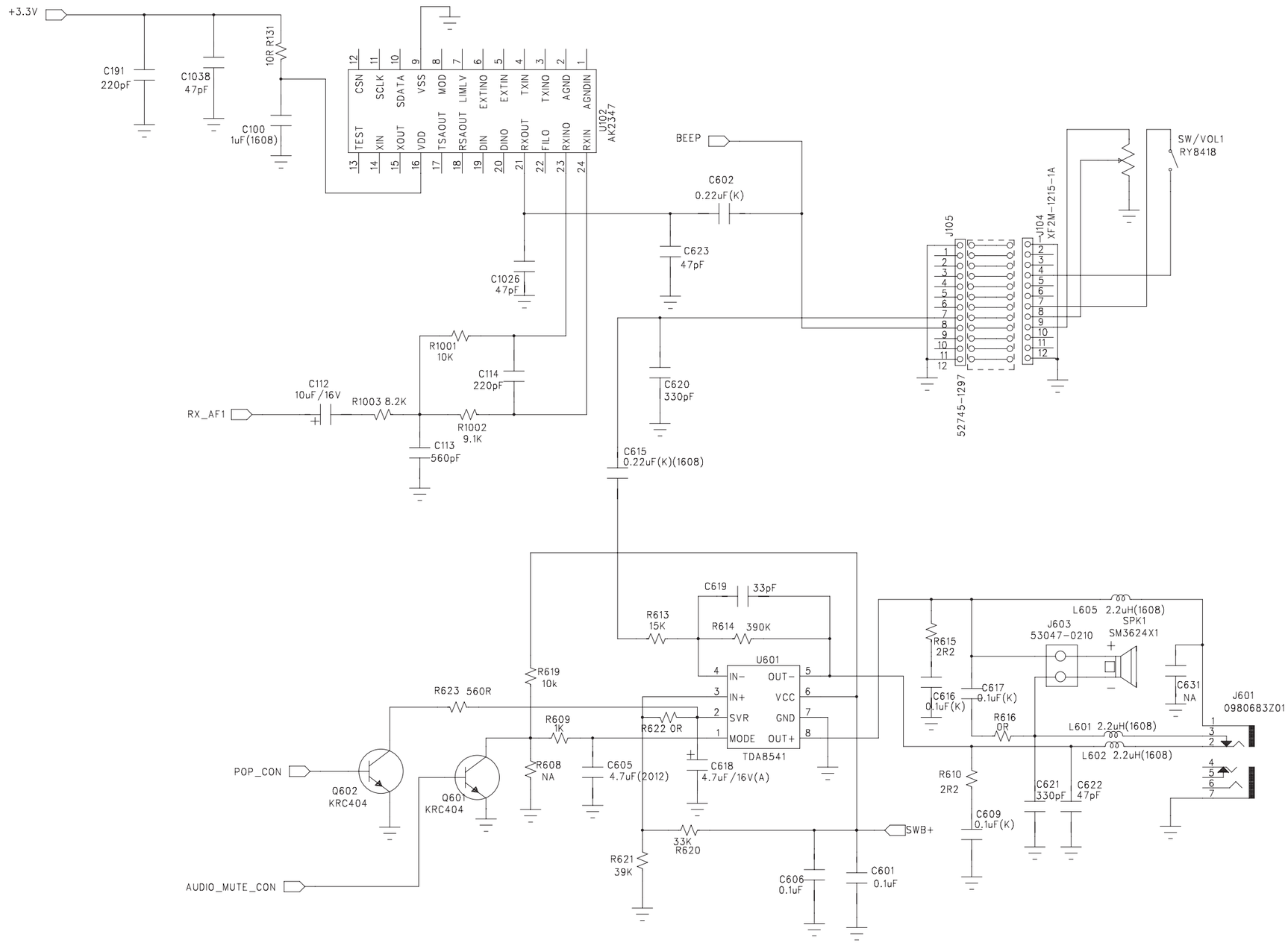


Figure 13-7. Audio Power Amplifier and External Audio Schematic Diagram

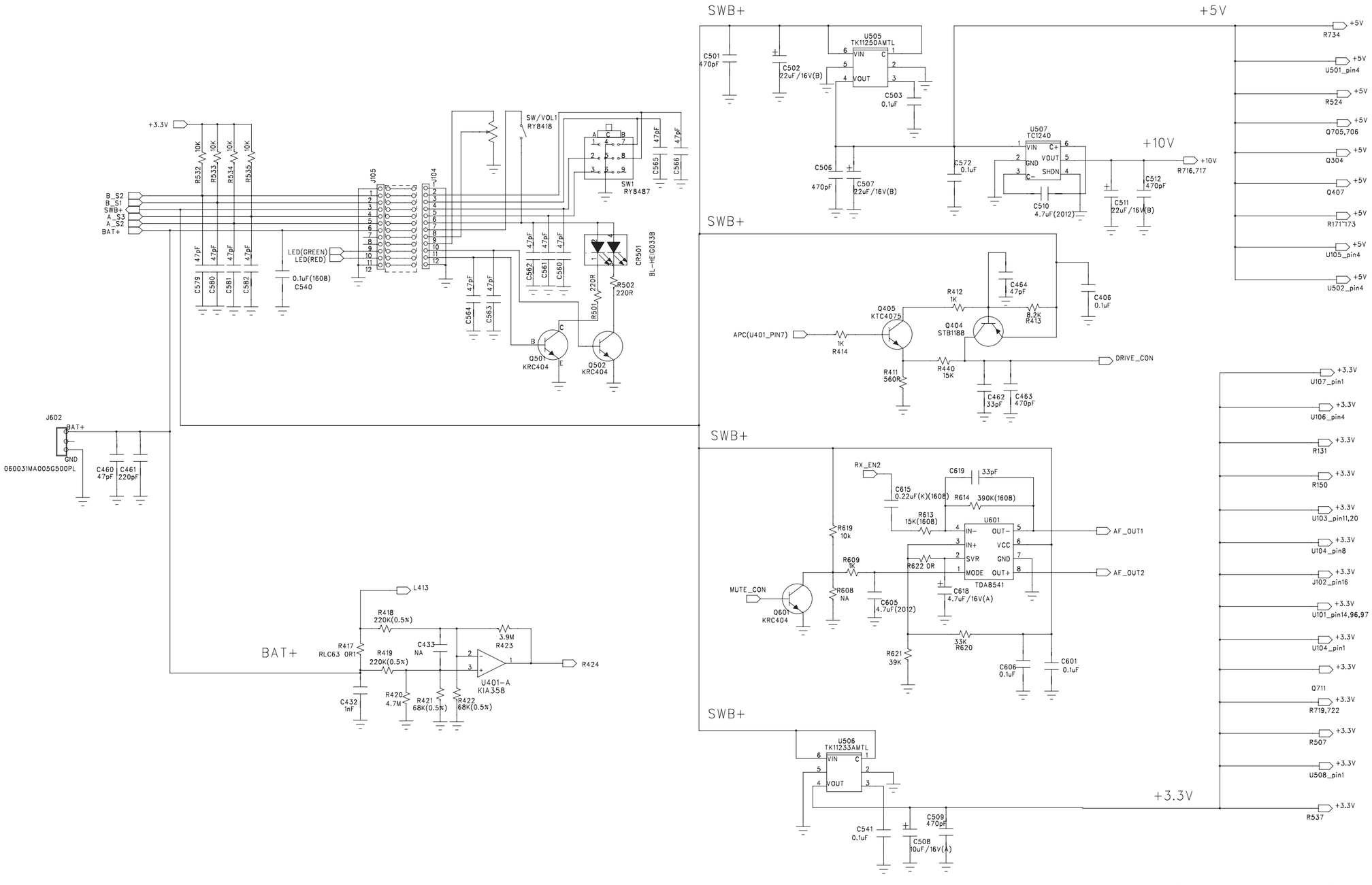


Figure 13-8. Switches and Battery Schematic Diagram

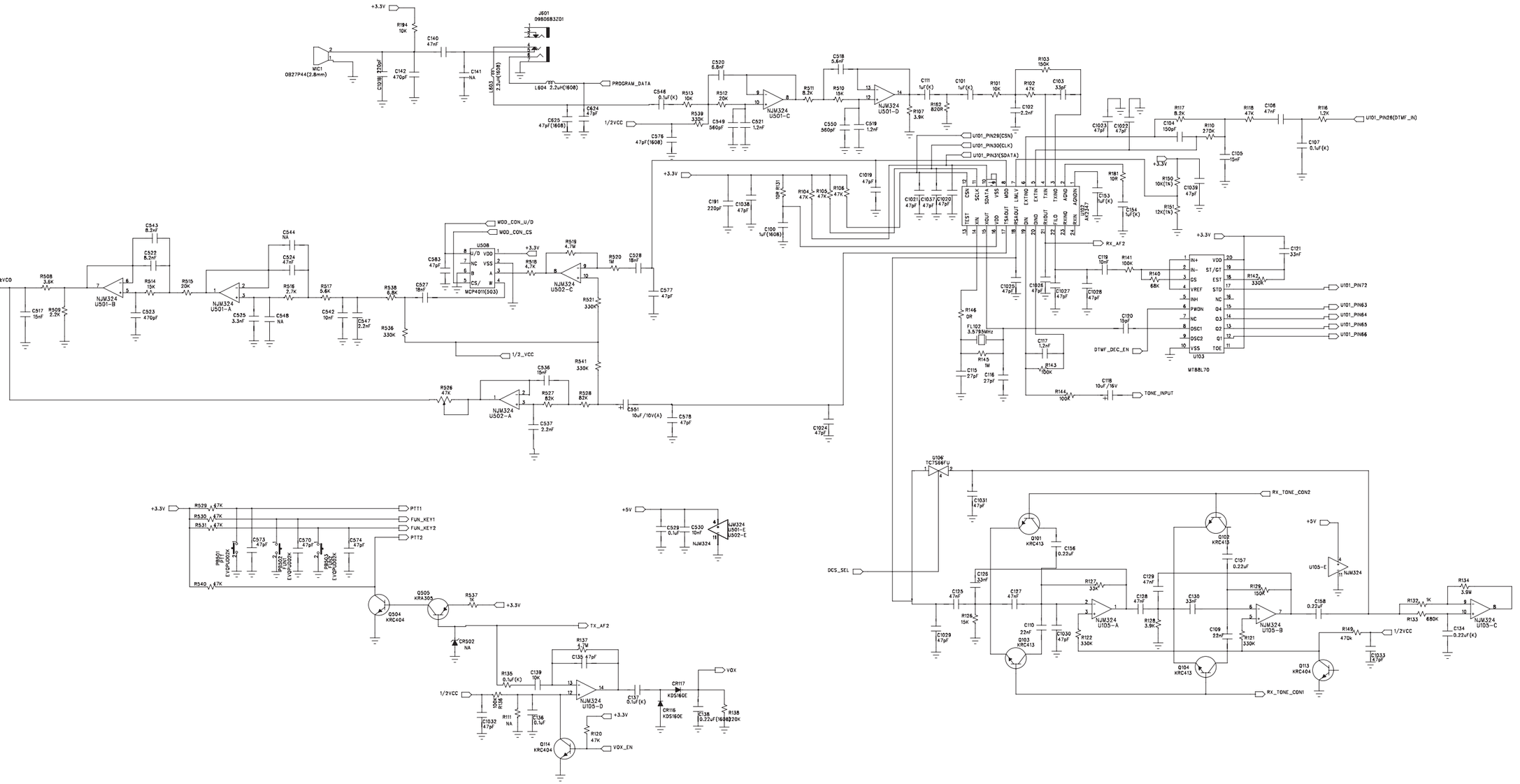


Figure 13-9. Transmitter Audio Filter and Sub-tone Schematic Diagram

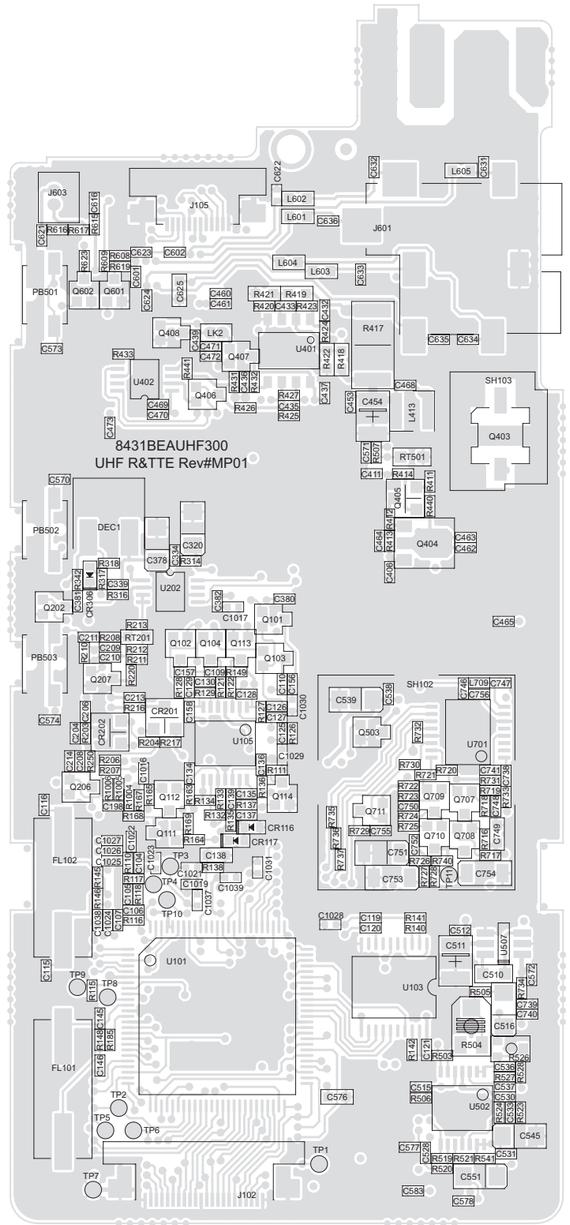
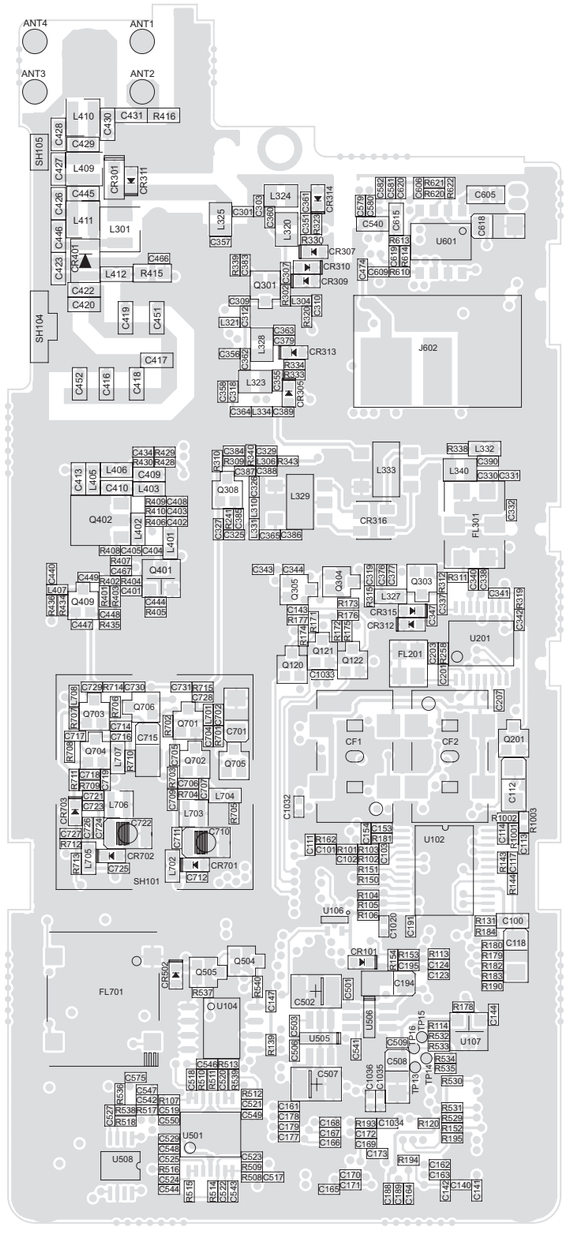


Figure 13-10. UHF1 (403–447 MHz) Mainboard Top Side: PCB No. 8431BEAUHF300


ANT4
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ANT2
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SH104
SH101
L301
L411
L409
L410
L412
L324
L325
L320
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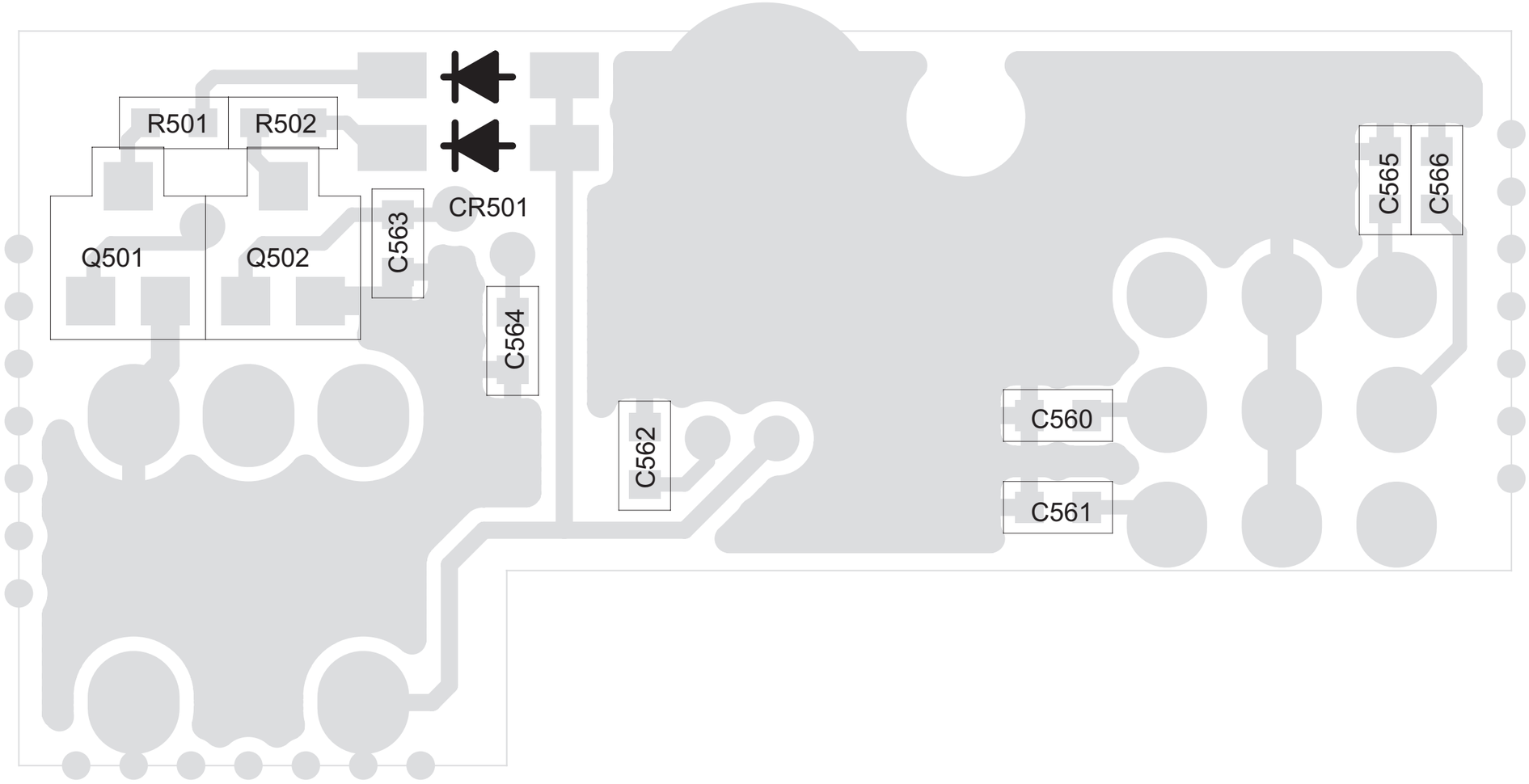


Figure 13-12. UHF1 (403–447 MHz) Sub Circuit Board Top View: PCB No. 8421BEACON100

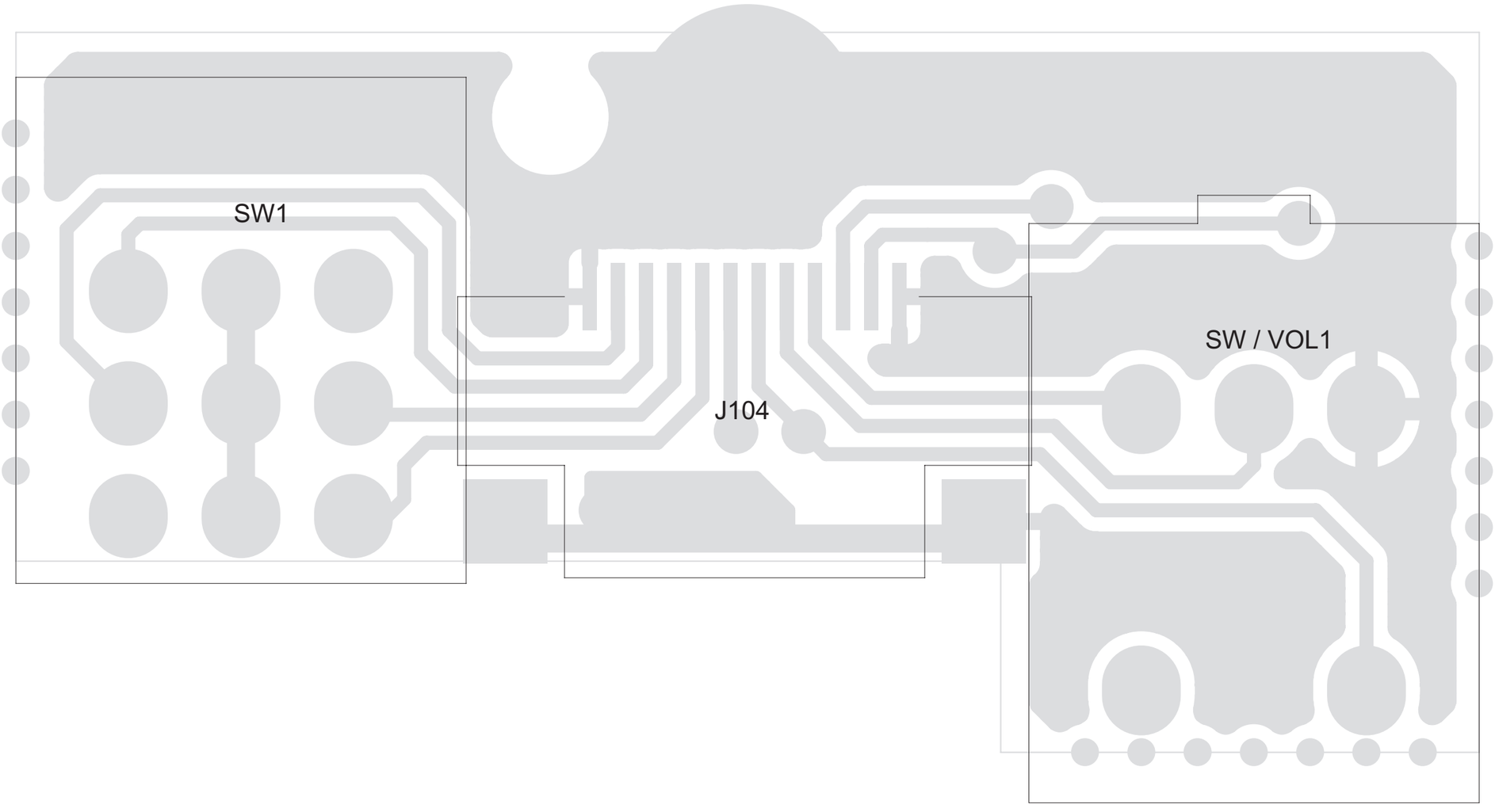
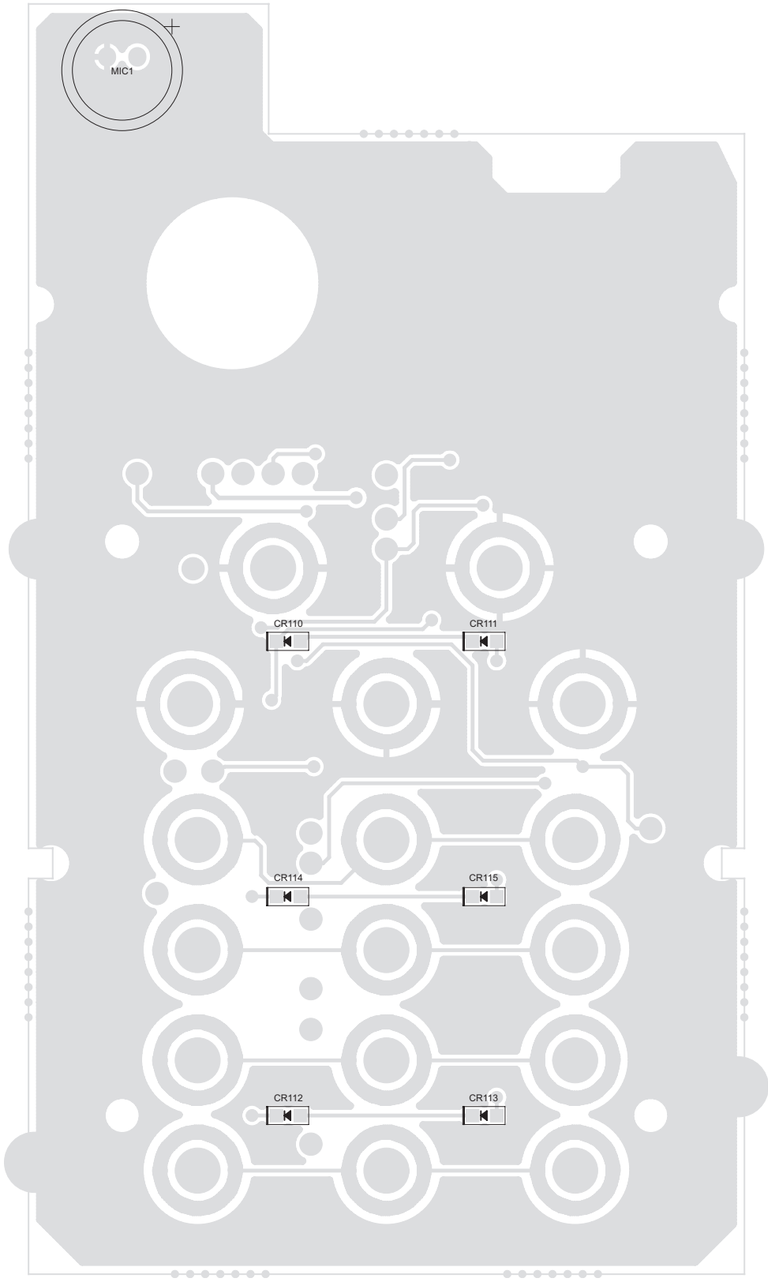


Figure 13-13. UHF1 (403–447 MHz) Sub Circuit Board Bottom View: PCB No. 8421BEACON100



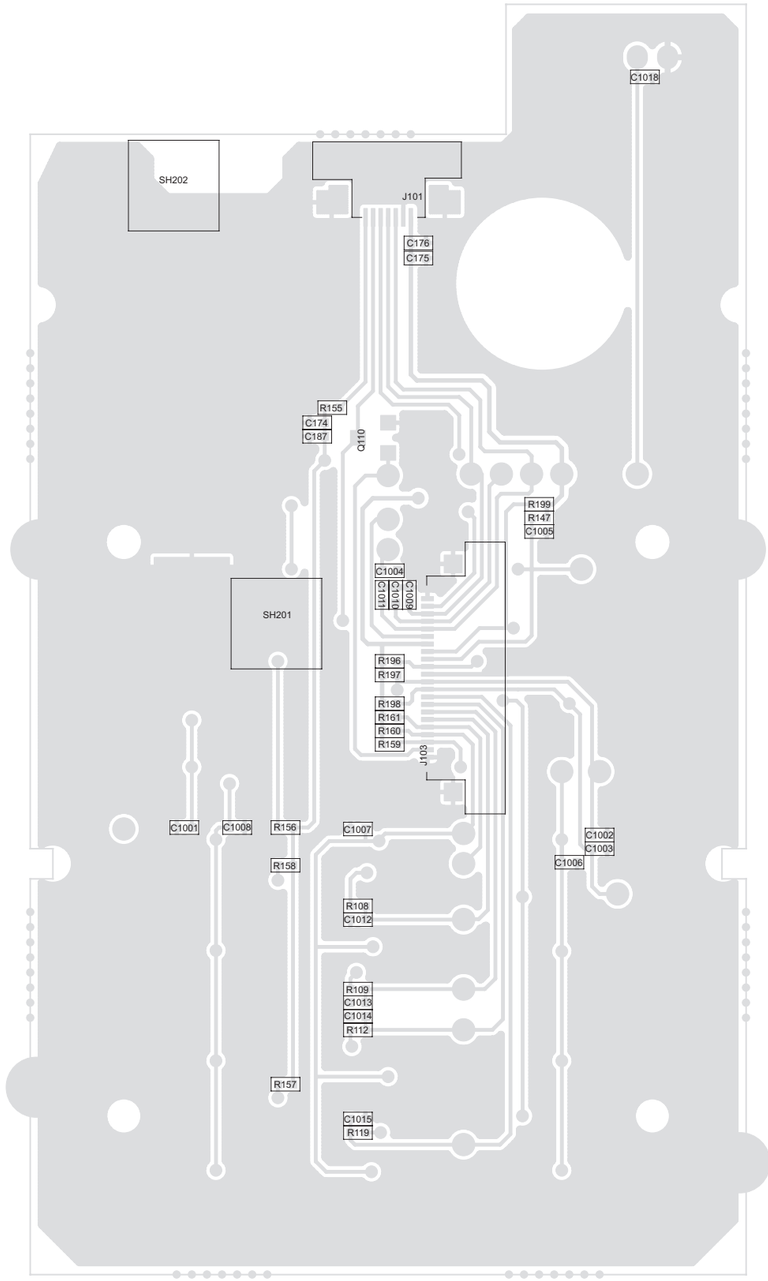


Figure 13-14. UHF1 (403–447 MHz) Keypad Board: PCB No. 8422BEACON100

13.3.1 Parts List

Circuit Ref.	Supplier	Supplier Part No.	Description
C100	TDK	N/A	Chip Cap, 1608 Z 1µF
C101	TDK	N/A	Chip Cap, 1005 K 1µF
C102	TDK	N/A	Chip Cap, 1005 K 2.2nF
C103	TDK	N/A	Chip Cap, 1005 J 33PF
C104	TDK	N/A	Chip Cap, 1005 J 150 PF
C105	TDK	N/A	Chip Cap, 1005 K 15nF
C106	TDK	N/A	Chip Cap, 1005 K 47nF
C107	TDK	N/A	Chip Cap,1005 K 0.1µF
C109	TDK	N/A	Chip Cap,1005 K 22nF
C110	TDK	N/A	Chip Cap,1005 K 22nF
C111	TDK	N/A	Chip Cap, 1005 K 1µF
C112[1]	HITACH	N/A	Chip Tantal, 10µF-M/16V(A)
C113[1]	TDK	N/A	Chip Cap,1005 K 560PF
C114[1]	TDK	N/A	Chip Cap,1005 J 220PF
C115[1]	TDK	N/A	Chip Cap, 1005 J 27PF
C116	TDK	N/A	Chip Cap, 1005 J 27PF
C117	TDK	N/A	Chip Cap, 1005 K 1.2nF
C118	HITACH	N/A	Chip Tantal, 10µF-M/16V(A)
C119	TDK	N/A	Chip Cap,1005 K 10nF
C120	TDK	N/A	Chip Cap, 1005 J 15PF
C121	TDK	N/A	Chip Cap,1005 K 33nF
C123	TDK	N/A	Chip Cap,1005 Z 0.1µF
C124	TDK	N/A	Chip Cap,1005 K 1nF
C125	TDK	N/A	Chip Cap, 1006 K 47nF
C126	TDK	N/A	Chip Cap,1005 K 33nF
C127	TDK	N/A	Chip Cap, 1006 K 47nF
C128	TDK	N/A	Chip Cap, 1006 K 47nF
C129	TDK	N/A	Chip Cap, 1006 K 47nF
C130	TDK	N/A	Chip Cap,1005 K 33nF
C134	TDK	N/A	Chip Cap,1005 K 0.22µF
C135	TDK	N/A	Chip Cap,1005 J 47PF
C136	TDK	N/A	Chip Cap,1005 Z 0.1µF
C137	TDK	N/A	Chip Cap,1005 K 0.1µF
C138	TDK	N/A	Chip Cap, 1608 K 0.22µF
C139	KAMAYA	N/A	Chip Res, 1005 J 10KW
C140	TDK	N/A	Chip Cap, 1006 K 47nF
C142	TDK	N/A	Chip Cap,1005 K 470PF
C143	TDK	N/A	Chip Cap,1005 Z 0.1µF
C144	TDK	N/A	Chip Cap,1005 K 0.1µF
C145	TDK	N/A	Chip Cap, 1005 J 15PF
C146	TDK	N/A	Chip Cap, 1005 J 15PF
C147	TDK	N/A	Chip Cap,1005 K 0.1µF
C153	TDK	N/A	Chip Cap, 1005 K 0.1µF
C154	TDK	N/A	Chip Cap, 1005 K 0.1µF
C156	TDK	N/A	Chip Cap,1005 K 0.22µF
C157	TDK	N/A	Chip Cap,1005 K 0.22µF
C158	TDK	N/A	Chip Cap,1005 K 0.22µF
C161	TDK	N/A	Chip Cap,1005 J 220PF
C162	TDK	N/A	Chip Cap,1005 J 220PF
C163	TDK	N/A	Chip Cap,1005 J 220PF
C164	TDK	N/A	Chip Cap,1005 J 220PF
C165	TDK	N/A	Chip Cap,1005 J 220PF
C166	TDK	N/A	Chip Cap,1005 J 220PF
C167	TDK	N/A	Chip Cap,1005 J 220PF
C168	TDK	N/A	Chip Cap,1005 J 220PF
C169	TDK	N/A	Chip Cap,1005 J 220PF
C170	TDK	N/A	Chip Cap,1005 J 220PF
C171	TDK	N/A	Chip Cap,1005 J 220PF
C172	TDK	N/A	Chip Cap,1005 J 220PF
C173	TDK	N/A	Chip Cap,1005 J 220PF
C174	TDK	N/A	Chip Cap,1005 J 220PF
C175	TDK	N/A	Chip Cap,1005 Z 0.1µF
C176	TDK	N/A	Chip Cap,1005 J 220PF
C177	TDK	N/A	Chip Cap,1005 J 220PF
C178	TDK	N/A	Chip Cap,1005 J 220PF
C179	TDK	N/A	Chip Cap,1005 J 220PF
C187	TDK	N/A	Chip Cap,1005 Z 0.1µF
C188	TDK	N/A	Chip Cap,1005 J 220PF
C189	TDK	N/A	Chip Cap,1005 J 220PF
C191	TDK	N/A	Chip Cap,1005 J 220PF
C194	HITACH	N/A	Chip Tantal, 10µF-M/16V(A)
C195	TDK	N/A	Chip Cap,1005 J 220PF
C201	TDK	N/A	Chip Cap,1005 J 47PF
C203	TDK	N/A	Chip Cap,1005 J 82PF
C204	TDK	N/A	Chip Cap,1005 Z 0.1µF
C206	TDK	N/A	Chip Cap,1005 K 0.1µF
C207	TDK	N/A	Chip Cap,1005 K 0.1µF
C208	TDK	N/A	Chip Cap,1005 Z 0.1µF
C209	TDK	N/A	Chip Cap,1005 K 470PF
C210	TDK	N/A	Chip Cap,1005 K 470PF
C211	TDK	N/A	Chip Cap,1005 K 0.1µF
C213	TDK	N/A	Chip Cap,1005 K 0.1µF
C214	TDK	N/A	Chip Cap,1005 Z 0.1µF
C301	TDK	N/A	Chip Cap,1005 D 8PF
C303	TDK	N/A	Chip Cap,1005 C 5PF
C307	TDK	N/A	Chip Cap, 1005 J 12PF
C310	TDK	N/A	Chip Cap,1005 Z 0.1µF
C312	TDK	N/A	Chip Cap,1005 C 3PF
C318	TDK	N/A	Chip Cap,1005 J 15PF
C319	TDK	N/A	Chip Cap,1005 K 10nF
C320	HITACH	N/A	Chip Tantal, 10µF-M/16V(A)
C326	TDK	N/A	Chip Cap,1005 D 8PF
C327	TDK	N/A	Chip Cap,1005 D 7PF
C329	TDK	N/A	Chip Cap,1005 K 10nF

Circuit Ref.	Supplier	Supplier Part No.	Description
C330	TDK	N/A	Chip Cap,1005 J 47PF
C331	TDK	N/A	Chip Cap,1005 J 20PF
C332	MURATA	N/A	Chip Cap, 1005 J 11PF
C334	TDK	N/A	Chip Cap,1005 K 1nF
C337	TDK	N/A	Chip Cap,1005 K 10nF
C338	TDK	N/A	Chip Cap, 1006 K 47nF
C339	TDK	N/A	Chip Cap,1005 K 0.1µF
C340	TDK	N/A	Chip Cap,1005 K 0.1µF
C341	TDK	N/A	Chip Cap,1005 J 56PF
C342	TDK	N/A	Chip Cap,1005 K 0.1µF
C343	TDK	N/A	Chip Cap,1005 Z 0.1µF
C344	TDK	N/A	Chip Cap,1005 K 470PF
C347	TDK	N/A	Chip Cap,1005 Z 0.1µF
C351	TDK	N/A	Chip Cap,1005 J 12PF
C355	TDK	N/A	Chip Cap,1005 D 10PF
C356	TDK	N/A	Chip Cap,1005 C 3PF
C357	TDK	N/A	Chip Cap,1005 J 56PF
C358	TDK	N/A	Chip Cap,1005 J 15PF
C360	TDK	N/A	Chip Cap,1005 C 4PF
C361	TDK	N/A	Chip Cap,1005 J 15PF
C362	TDK	N/A	Chip Cap,1005 C 3PF
C363	TDK	N/A	Chip Cap,1005 C 1PF
C364	TDK	N/A	Chip Cap,1005 J 33PF
C365	KAMAYA	N/A	Chip Res, 1005 J 0?
C376	TDK	N/A	Chip Cap,1005 Z 0.1µF
C378	HITACH	N/A	Chip Tantal, 10µF-M/16V(A)
C379	TDK	N/A	Chip Cap,1005 D 10PF
C380	TDK	N/A	Chip Cap,1005 J 47PF
C381	TDK	N/A	Chip Cap,1005 K 0.1µF
C382	TDK	N/A	Chip Cap,1005 Z 0.1µF
C383	TDK	N/A	Chip Cap,1005 K 1nF
C385	TDK	N/A	Chip Cap,1005 K 470PF
C386	TDK	N/A	Chip Cap,1005 J 12PF
C387	TDK	N/A	Chip Cap,1005 D 8PF
C388	TDK	N/A	Chip Cap,1005 D 10PF
C390	TDK	N/A	Chip Cap,1005 J 56PF
C401	TDK	N/A	Chip Cap,1005 C 3PF
C402	TDK	N/A	Chip Cap,1005 K 10nF
C403	TDK	N/A	Chip Cap,1005 K 470PF
C404	TDK	N/A	Chip Cap, 1005 J 56PF
C405	TDK	N/A	Chip Cap, 1005 J 56PF
C406	TDK	N/A	Chip Cap,1005 Z 0.1µF
C408	TDK	N/A	Chip Cap,1005 K 10nF
C409	TDK	N/A	Chip Cap,1608 J 18PF
C410	TDK	N/A	Chip Cap, 1608 J 39PF
C413	TDK	N/A	Chip Cap,1608 J 27PF
C416	TDK	N/A	Chip Cap,1608 C 8PF
C417	TDK	N/A	Chip Cap,1608 C 8PF
C418	TDK	N/A	Chip Cap,1608 J 15PF
C419	TDK	N/A	Chip Cap,1608 C 6PF
C420	TDK	N/A	Chip Cap,1608 J 12PF
C422	TDK	N/A	Chip Cap,1608 C 8PF
C426	TDK	N/A	Chip Cap,1608 D 7PF
C427	TDK	N/A	Chip Cap,1608 C 4PF
C428	TDK	N/A	Chip Cap,1608 D 7PF
C429	TDK	N/A	Chip Cap,1608 C 3PF
C431	TDK	N/A	Chip Cap,1608 J 1nF
C432	TDK	N/A	Chip Cap,1005 K 1nF
C434	TDK	N/A	Chip Cap,1005 K 470PF
C435	TDK	N/A	Chip Cap, 1006 K 47nF
C436	TDK	N/A	Chip Cap,1005 Z 0.1µF
C437	TDK	N/A	Chip Cap,1005 Z 0.1µF
C439	TDK	N/A	Chip Cap,1005 K 1nF
C440	TDK	N/A	Chip Cap,1005 K 470PF
C445	TDK	N/A	Chip Cap,1608 C 6PF
C446	TDK	N/A	Chip Cap,1608 C 3PF
C447	TDK	N/A	Chip Cap,1005 C 3PF
C448	TDK	N/A	Chip Cap,1005 K 10nF
C449	TDK	N/A	Chip Cap,1005 C 3PF
C451	TDK	N/A	Chip Cap,1608 C 6PF
C452	TDK	N/A	Chip Cap,1608 J 47PF
C453	TDK	N/A	Chip Cap,1005 K 470PF
C454	HITACH	N/A	Chip Tantal, 22µF-M/16V(B)
C460	TDK	N/A	Chip Cap,1005 J 47PF
C461	TDK	N/A	Chip Cap,1005 Z 0.1µF
C462	TDK	N/A	Chip Cap,1005 J 33PF
C463	TDK	N/A	Chip Cap,1005 K 470PF
C464	TDK	N/A	Chip Cap,1005 J 47PF
C465	TDK	N/A	Chip Cap,1005 K 470PF
C466	TDK	N/A	Chip Cap,1005 K 470PF
C467	TDK	N/A	Chip Cap,1005 K 470PF
C469	TDK	N/A	Chip Cap,1005 Z 0.1µF
C470	TDK	N/A	Chip Cap,1005 J 47PF
C471	TDK	N/A	Chip Cap,1005 Z 0.1µF
C472	TDK	N/A	Chip Cap,1005 K 470PF
C473	TDK	N/A	Chip Cap,1005 J 47PF
C474	TDK	N/A	Chip Cap,1005 Z 0.1µF
C501	TDK	N/A	Chip Cap,1005 K 470PF
C502	HITACH	N/A	Chip Tantal, 22µF-M/16V(B)
C503	TDK	N/A	Chip Cap,1005 Z 0.1µF
C506	TDK	N/A	Chip Cap,1005 K 470PF
C507	HITACH	N/A	Chip Tantal, 22µF-M/16V(B)
C508	HITACH	N/A	Chip Tantal, 10µF-M/16V(A)
C509	TDK	N/A	Chip Cap,1005 K 470PF
C510	TDK	N/A	Chip Cap, 2012 Z 4.7µF
C511	HITACH	N/A	Chip Tantal, 22µF-M/16V(B)

Circuit Ref.	Supplier	Supplier Part No.	Description
C512	TDK	N/A	Chip Cap,1005 K 470PF
C515	TDK	N/A	Chip Cap,1005 Z 0.1µF
C516	HITACH	N/A	Chip Tantal, 10µF-M/16V(A)
C517	TDK	N/A	Chip Cap,1005 K 15nF
C518	TDK	N/A	Chip Cap, 1005 K 5.6nF
C519	TDK	N/A	Chip Cap, 1005 K 1.2nF
C520	TDK	N/A	Chip Cap, 1005 K 6.8nF
C521	TDK	N/A	Chip Cap, 1005 K 1.2nF
C522	TDK	N/A	Chip Cap, 1005 K 8.2nF
C523	TDK	N/A	Chip Cap,1005 K 470PF
C524	TDK	N/A	Chip Cap,1005 K 47nF
C525	TDK	N/A	Chip Cap, 1005 K 3.3nF
C527	TDK	N/A	Chip Cap, 1005 K 18nF
C528	TDK	N/A	Chip Cap, 1005 K 18nF
C529	TDK	N/A	Chip Cap,1005 Z 0.1µF
C530	TDK	N/A	Chip Cap,1005 K 10nF
C531	TDK	N/A	Chip Cap,1005 Z 0.1µF
C533	TDK	N/A	Chip Cap,1005 Z 0.1µF
C536	TDK	N/A	Chip Cap,1005 K 15nF
C537	TDK	N/A	Chip Cap, 1005 K 2.2µF
C538	TDK	N/A	Chip Cap,1005 K 10nF
C539	HITACH	N/A	Chip Tantal, 10µF-M/16V(A)
C540	TDK	N/A	Chip Cap, 1608 Z 0.1µF
C541	TDK	N/A	Chip Cap,1005 Z 0.1µF
C542	TDK	N/A	Chip Cap,1005 K 10nF
C543	TDK	N/A	Chip Cap, 1005 K 8.2nF
C545	HITACH	N/A	Chip Tantal, 22µF-M/10V(A)
C546	TDK	N/A	Chip Cap,1005 K 0.1µF
C547	TDK	N/A	Chip Cap, 1005 K 2.2µF
C549	TDK	N/A	Chip Cap,1005 K 560PF
C550	TDK	N/A	Chip Cap,1005 K 560PF
C551	HITACH	N/A	Chip Tantal, 10µF-M/10V(A)

Circuit Ref.	Supplier	Supplier Part No.	Description
C560	TDK	N/A	Chip Cap,1005 J 47PF
C561	TDK	N/A	Chip Cap,1005 J 47PF
C562	TDK	N/A	Chip Cap,1005 J 47PF
C563	TDK	N/A	Chip Cap,1005 J 47PF
C564	TDK	N/A	Chip Cap,1005 J 47PF
C565	TDK	N/A	Chip Cap,1005 J 47PF
C566	TDK	N/A	Chip Cap,1005 J 47PF
C570	TDK	N/A	Chip Cap,1005 J 47PF
C571	TDK	N/A	Chip Cap,1005 K 15nF
C572	TDK	N/A	Chip Cap,1005 Z 0.1µF
C573	TDK	N/A	Chip Cap,1005 J 47PF
C574	TDK	N/A	Chip Cap,1005 J 47PF
C575	TDK	N/A	Chip Cap,1005 J 47PF
C576	TDK	N/A	Chip Cap,1608 J 47PF
C577	TDK	N/A	Chip Cap,1005 J 47PF
C578	TDK	N/A	Chip Cap,1005 J 47PF
C579	TDK	N/A	Chip Cap,1005 J 47PF
C580	TDK	N/A	Chip Cap,1005 J 47PF
C581	TDK	N/A	Chip Cap,1005 J 47PF
C582	TDK	N/A	Chip Cap,1005 J 47PF
C583	TDK	N/A	Chip Cap,1005 J 47PF
C601	TDK	N/A	Chip Cap,1005 Z 0.1µF
C602	TDK	N/A	Chip Cap,1005 K 0.22µF
C605	TDK	N/A	Chip Cap, 2012 Z 4.7µF
C606	TDK	N/A	Chip Cap,1005 Z 0.1µF
C609	TDK	N/A	Chip Cap,1005 K 0.1µF
C615	TDK	N/A	Chip Cap, 1608 K 0.22µF
C616	TDK	N/A	Chip Cap,1005 K 0.1µF
C617	TDK	N/A	Chip Cap,1005 K 0.1µF
C618	HITACH	N/A	Chip Tantal, 4.7µF-M/16V(A)
C619	TDK	N/A	Chip Cap, 1005 J 33PF
C620	TDK	N/A	Chip Cap,1005 K 330PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C621	TDK	N/A	Chip Cap,1005 K 330PF
C622	TDK	N/A	Chip Cap, 1005 J 47PF
C623	TDK	N/A	Chip Cap, 1005 J 47PF
C624	TDK	N/A	Chip Cap, 1005 J 47PF
C625	TDK	N/A	Chip Cap, 1608 J 47PF
C701	HITACH	N/A	Chip Tantal, 22µF-M/10V(A)
C702	TDK	N/A	Chip Cap,1005 K 1nF
C704	TDK	N/A	Chip Cap,1005 K 1nF
C705	TDK	N/A	Chip Cap,1005 C 3PF
C706	TDK	N/A	Chip Cap, 1005 D 9PF
C707	TDK	N/A	Chip Cap, 1005 J 18PF
C709	TDK	N/A	Chip Cap, 1005 D 7PF
C710	MURATA	N/A	Chip Trimmer Cap, 2PIE 6PF
C711	MURATA	N/A	Chip Cap, 1005 J 16PF
C712	TDK	N/A	Chip Cap,1005 K 470PF
C714	TDK	N/A	Chip Cap,1005 K 1nF
C715	HITACH	N/A	Chip Tantal, 22µF-M/10V(A)
C716	TDK	N/A	Chip Cap,1005 K 470PF
C717	TDK	N/A	Chip Cap, 1005 C 3PF
C718	TDK	N/A	Chip Cap, 1005 C 4PF
C719	TDK	N/A	Chip Cap, 1005 D 7PF
C721	TDK	N/A	Chip Cap, 1005 C 3PF
C722	MURATA	N/A	Chip Trimmer Cap, 2PIE 6PF
C723	TDK	N/A	Chip Cap, 1005 C 0.5PF
C724	TDK	N/A	Chip Cap, 1005 J 12PF
C725	TDK	N/A	Chip Cap,1005 K 470PF
C726	TDK	N/A	Chip Cap,1005 C 1PF
C727	TDK	N/A	Chip Cap,1005 C 3PF
C728	TDK	N/A	Chip Cap,1005 C 5PF
C729	TDK	N/A	Chip Cap, 1005 D 6PF
C730	TDK	N/A	Chip Cap, 1005 C 2PF
C731	TDK	N/A	Chip Cap, 1005 C 2PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C738.	TDK	N/A	Chip Cap, 1005 D 7PF
C739	TDK	N/A	Chip Cap,1005 K 1nF
C740	TDK	N/A	Chip Cap,1005 Z 0.1µF
C741	TDK	N/A	Chip Cap,1005 Z 0.1µF
C746	TDK	N/A	Chip Cap, 1005 D 10PF
C747	TDK	N/A	Chip Cap, 1005 D 10PF
C748	TDK	N/A	Chip Cap,1005 Z 0.1µF
C749	TDK	N/A	Chip Cap, 1608 Z 0.1µF
C750	TDK	N/A	Chip Cap,1005 Z 0.1µF
C751	HITACH	N/A	Chip Tantal, 1µF-M/35V(A)
C752	TDK	N/A	Chip Cap,1005 K 0.1µF
C753	PANASONIC	N/A	Film Chip Cap, 3216 J 47nF
C754	PANASONIC	N/A	Film Chip Cap, 3216 J 47nF
C755	TDK	N/A	Chip Cap,1005 K 0.1µF
C756	TDK	N/A	Chip Cap,1005 K 1nF
C1001	TDK	N/A	Chip Cap, 1005 J 47PF
C1002	TDK	N/A	Chip Cap, 1005 J 47PF
C1003	TDK	N/A	Chip Cap, 1005 J 47PF
C1004	TDK	N/A	Chip Cap, 1005 J 47PF
C1005	TDK	N/A	Chip Cap, 1005 J 47PF
C1006	TDK	N/A	Chip Cap, 1005 J 47PF
C1007	TDK	N/A	Chip Cap, 1005 J 47PF
C1008	TDK	N/A	Chip Cap, 1005 J 47PF
C1009	TDK	N/A	Chip Cap, 1005 J 47PF
C1010	TDK	N/A	Chip Cap, 1005 J 47PF
C1011	TDK	N/A	Chip Cap, 1005 J 47PF
C1012	TDK	N/A	Chip Cap, 1005 J 47PF
C1013	TDK	N/A	Chip Cap, 1005 J 47PF
C1014	TDK	N/A	Chip Cap, 1005 J 47PF
C1015	TDK	N/A	Chip Cap, 1005 J 47PF
C1016	TDK	N/A	Chip Cap,1005 Z 0.1µF
C1017	TDK	N/A	Chip Cap,1005 K 470PF

Circuit Ref.	Supplier	Supplier Part No.	Description
C1018	TDK	N/A	Chip Cap, 1005 J 220PF
C1019	TDK	N/A	Chip Cap, 1005 J 47PF
C1020	TDK	N/A	Chip Cap, 1005 J 47PF
C1021	TDK	N/A	Chip Cap, 1005 J 47PF
C1022	TDK	N/A	Chip Cap, 1005 J 47PF
C1023	TDK	N/A	Chip Cap, 1005 J 47PF
C1024	TDK	N/A	Chip Cap, 1005 J 47PF
C1025	TDK	N/A	Chip Cap, 1005 J 47PF
C1026	TDK	N/A	Chip Cap, 1005 J 47PF
C1027	TDK	N/A	Chip Cap, 1005 J 47PF
C1028	TDK	N/A	Chip Cap, 1005 J 47PF
C1029	TDK	N/A	Chip Cap, 1005 J 47PF
C1030	TDK	N/A	Chip Cap, 1005 J 47PF
C1031	TDK	N/A	Chip Cap, 1005 J 47PF
C1032	TDK	N/A	Chip Cap, 1005 J 47PF
C1033	TDK	N/A	Chip Cap, 1005 J 47PF
C1034	TDK	N/A	Chip Cap, 1005 J 47PF
C1035	TDK	N/A	Chip Cap, 1005 J 47PF
C1036	TDK	N/A	Chip Cap, 1005 J 47PF
C1037	TDK	N/A	Chip Cap, 1005 J 47PF
C1038	TDK	N/A	Chip Cap, 1005 J 47PF
C1039	TDK	N/A	Chip Cap, 1005 J 47PF
CF1	BGTech	8286045500120	TOKO, Ceramic Filter, ELFY455F
CF2	BGTech	8286045500220	TOKO, Ceramic Filter, ELFY455H
CR110	Bright LED	N/A	LED DIODE, BL-HG036D-TR
CR111	Bright LED	N/A	LED DIODE, BL-HG036D-TR
CR112[1]	Bright LED	N/A	LED DIODE, BL-HG036D-TR
CR113[1]	Bright LED	N/A	LED DIODE, BL-HG036D-TR
CR114[1]	Bright LED	N/A	LED DIODE, BL-HG036D-TR
CR115[1]	Bright LED	N/A	LED DIODE, BL-HG036D-TR

Circuit Ref.	Supplier	Supplier Part No.	Description
CR116	KEC	N/A	SWITCH DIODE, KDS-160E (ESM)
CR117	KEC	N/A	SWITCH DIODE, KDS-160E (ESM)
CR201	KEC	N/A	Switch DIODE, KDS 181
CR202	KEC	N/A	Switch DIODE, KDS 181
CR301	KEC	N/A	Switch DIODE, KDS 114
CR305	KEC	N/A	VARIABLE DIODE, KDV154E (ESM)
CR306	KEC	N/A	SWITCH DIODE, KDS-160E (ESM)
CR307	KEC	N/A	VARIABLE DIODE, KDV154E (ESM)
CR309	KEC	N/A	Switch DIODE, KDS 114E (ESD)
CR310	KEC	N/A	Switch DIODE, KDS 114E (ESD)
CR312	KEC	N/A	SWITCH DIODE, KDS-160E (ESM)
CR313	KEC	N/A	VARIABLE DIODE, KDV154E (ESM)
CR314	KEC	N/A	VARIABLE DIODE, KDV154E (ESM)
CR315	KEC	N/A	SWITCH DIODE, KDS-160E (ESM)
CR316	BGTech	8157MS2829020	Schotty DIODE, HSMS-2829
CR401	M/A COM	N/A	PIN DIODE, MA4P7001F-1072T
CR501	BRIGHT LED	N/A	LED DIODE, BL-HEIG033B-TR
CR701	KEC	N/A	VARIABLE DIODE, KDV154E (ESM)
CR702	KEC	N/A	VARIABLE DIODE, KDV154E (ESM)
CR703	KEC	N/A	VARIABLE DIODE, KDV154E (ESM)
DEC1	BGTech	8287455C24010	CP, Desciminator, JTBC455C24

Circuit Ref.	Supplier	Supplier Part No.	Description
F-CABLE1	BGTech	8560228005000	SNAGGWA, BEACON FLAT CABLE, FF12-22N080XXA
F-CABLE2	BGTech	8560124005001	SNAGGWA, BEACON FLAT CABLE, FF12-12N040XXA
FL101	BGTech	82827R3728M00	SHINSUNG, Crystal, 7.3728MHz (H: 2.8mm)
FL102	BGTech	82827R5795M00	SHINSUNG, Crystal, 3.5795MHz (H: 2.8mm)
FL201	BGTech	828244R645M00	SHINSUNG, Crystal, 44.645MHz (SMD)
FL301	BGTech	828645R100220	SHINSUNG, Crystal, MCF 45.15S12.B (8.5KHz)
FL701	BGTech	8289012R80010	SHINSUNG, VCTCXO, 12.8 MHZ
J101	BGTech	851607C01S110	YUNHO, FPC CONNECTOR, 05004HR-07C01S(G)
J102	BGTech	851622A01S110	YUNHO, FPC CONNECTOR, 05004HR-22A01S
J103	BGTech	8516220005020	KYOCERA, FPC CONNECTOR, 04-6292-022-000-800+
J104	BGTech	851612151A110	OMIRON, FPC CONNECTOR, XF2M-1215-1A
J105	BGTech	8516220R50100	MOLEX, FPC CONNECTOR, 52745-1297
J601	BGTech	8500031009800	CHI CHENG, SPK MIC JACK, 0980683Z01-D
J602	BGTech	85100G500PL00	SUYIN, BATTERY CONNECTOR, 060031MA005G500PL
J603	BGTech	8510530470210	MOLEX, CONNECTOR, 53047-0210
L301	DAERIM	N/A	COIL AIR, 0.45-1.4-5TL(SMD)
L304	TAIYOYUDEN	N/A	Chip Ind, 1005 J 39N
L306	TAIYOYUDEN	N/A	Chip Ind, 1005 J 33N
L310	TAIYOYUDEN	N/A	Chip Ind, 1005 J 22N
L320	DELTA	N/A	Chip Ind, 2012 27nH
L323	DELTA	N/A	Chip Ind, 2012 27nH
L324	DELTA	N/A	Chip Ind, 2012 27nH
L325	DELTA	N/A	Chip Ind, 2012 220nH

Circuit Ref.	Supplier	Supplier Part No.	Description
L327	TAIYOYUDEN	N/A	Chip Ind,1608 K 820NH
L328	DELTA	N/A	Chip Ind, 2012 27nH
L329	BGTech	8920PT1667020	TOKO, #617PT-1667
L331	TAIYOYUDEN	N/A	Chip Ind, 1005 J 22N
L332	TAIYOYUDEN	N/A	Chip Ind,1608 K 220NH
L333	BGTech	8920PT1667020	TOKO, #617PT-1667
L334	KAMAYA	N/A	Chip Res, 1005 J 0?
L340	DELTA	N/A	Chip Ind, 2012 820nH
L401	TAIYOYUDEN	N/A	Chip Ind, 1608 27nH J
L402	TAIYOYUDEN	N/A	Chip Ind, 1608 22nH J
L403	TAIYOYUDEN	N/A	Chip Ind, 1608 33nH J
L405	TAIYOYUDEN	N/A	Chip Ind, 1608 6.8nH J
L406	TAIYOYUDEN	N/A	Chip Ind, 1608 220nH J
L407	TAIYOYUDEN	N/A	Chip Ind, 1005 J 33nH
L409	DAERIM	N/A	COIL AIR, 0.45-1.4-3TL(SMD)
L410	DAERIM	N/A	COIL AIR, 0.45-1.4-3TL(SMD)
L411	DAERIM	N/A	COIL AIR, 0.45-1.4-3TL(SMD)
L412	TAIYOYUDEN	N/A	Chip Ind, 1608 220nH J
L413	DAERIM	N/A	COIL AIR, 0.35-1.6-7TL(SMD)
L601	TAIYOYUDEN	N/A	Chip Ind, 1608 K 2.2uH
L602	TAIYOYUDEN	N/A	Chip Ind, 1608 K 2.2uH
L603	TAIYOYUDEN	N/A	Chip Ind, 1608 K 2.2uH
L604	TAIYOYUDEN	N/A	Chip Ind, 1608 K 2.2uH
L605	TAIYOYUDEN	N/A	Chip Ind, 1608 K 2.2uH
L701	TAIYOYUDEN	N/A	Chip Ind, 1005 J 27nH
L702	TAIYOYUDEN	N/A	Chip Ind, 1608 K 2.2uH
L703	DAERIM	N/A	COIL AIR, 0.30-1.1-3TL(SMD)
L704	TAIYOYUDEN	N/A	Chip Ind, 1608 220nH J
L705	TAIYOYUDEN	N/A	Chip Ind, 1608 K 2.2uH

Circuit Ref.	Supplier	Supplier Part No.	Description
L706	DAERIM	N/A	COIL AIR, 0.30-1.1-3TL(SMD)
L707	TAIYOYUDEN	N/A	Chip Ind, 1608 220nH J
L708	TAIYOYUDEN	N/A	Chip Ind, 1005 J 27nH
L709	TAIYOYUDEN	N/A	Chip Ind, 1005 J 22nH
LCD1	BGTech	86343208A2020	EVERRVIEW,VBS3208A2-7FWLYA,REV4.0
MIC1	BGTech	8420063215000	BSE, C-MIC, 6.0*2.7/2.2KW ,2V,-44±3dB, Pin type
PB501	BGTech	8466PUD02K020	PANASONIC, Tack Switch, EVQPUD02K
PB502	BGTech	8466PUD02K020	PANASONIC, Tack Switch, EVQPUD02K
PB503	BGTech	8466PUD02K020	PANASONIC, Tack Switch, EVQPUD02K
Q101	KEC	N/A	KRC 413 BJT NPN Transistor
Q102	KEC	N/A	KRC 413 BJT NPN Transistor
Q103	KEC	N/A	KRC 413 BJT NPN Transistor
Q104	KEC	N/A	KRC 413 BJT NPN Transistor
Q110	KEC	N/A	KRC 101 BJT NPN Transistor
Q111	KEC	N/A	KTA 2014 BJT PNP Transistor
Q112	KEC	N/A	KTA 2014 BJT PNP Transistor
Q113	KEC	N/A	KRC 404 BJT NPN Transistor
Q114	KEC	N/A	KRC 404 BJT NPN Transistor
Q120	KEC	N/A	KRC 404 BJT NPN Transistor
Q121	KEC	N/A	KRC 404 BJT NPN Transistor
Q122	KEC	N/A	KRC 404 BJT NPN Transistor
Q201	KEC	N/A	KRC 404 BJT NPN Transistor
Q202	KEC	N/A	KRC 404 BJT NPN Transistor
Q206	KEC	N/A	KRC 404 BJT NPN Transistor
Q207	KEC	N/A	KRC 404 BJT NPN Transistor
Q301	HITACH	N/A	2SC4901 BJT NPN Transistor

Circuit Ref.	Supplier	Supplier Part No.	Description
Q303	NEC	N/A	2SC4226 BJT NPN Transistor
Q304	KEC	N/A	KRA 305 BJT PNP Transistor
Q305	KEC	N/A	KRC 404 BJT NPN Transistor
Q308	NEC	N/A	2SC4226 BJT NPN Transistor
Q401	BGTech	8142000951120	PBR 951LT1 PHILIPS BJT NPN Transistor
Q402	BGTech	8149003078021	2SK3078A TOSHIBA FET N-channel Transistor
Q403	BGTech	8149003476021	2SK3476 TOSHIBA FET N-channel Transistor
Q404	BGTech	8145001188021	STB 1188 AUK BJT NPN Transistor
Q405	KEC	N/A	KTC 4075 BJT NPN Transistor
Q406	KEC	N/A	KRC 404 BJT NPN Transistor
Q407	KEC	N/A	KRA 305 BJT PNP Transistor
Q408	KEC	N/A	KRC 404 BJT NPN Transistor
Q409	NEC	N/A	2SC4226 BJT NPN Transistor
Q501	KEC	N/A	KRC 404 BJT NPN Transistor
Q502	KEC	N/A	KRC 404 BJT NPN Transistor
Q503	KEC	N/A	KRC 404 BJT NPN Transistor
Q504	KEC	N/A	KRC 404 BJT NPN Transistor
Q505	KEC	N/A	KRA 305 BJT PNP Transistor
Q601	KEC	N/A	KRC 404 BJT NPN Transistor
Q602	KEC	N/A	KRC 404 BJT NPN Transistor
Q701	NEC	N/A	2SC4226 BJT NPN Transistor
Q702	NEC	N/A	2SC4226 BJT NPN Transistor
Q703	NEC	N/A	2SC4226 BJT NPN Transistor
Q704	NEC	N/A	2SC4226 BJT NPN Transistor
Q705	KEC	N/A	KRA 305 BJT PNP Transistor
Q706	KEC	N/A	KRA 305 BJT PNP Transistor
Q707	KEC	N/A	KTC 4075 BJT NPN Transistor
Q708	KEC	N/A	KTA 2014 BJT PNP Transistor
Q709	KEC	N/A	KTA 2014 BJT PNP Transistor
Q710	KEC	N/A	KTC 4075 BJT NPN Transistor
Q711	KEC	N/A	KRA304 BJT PNP Transistor
R101	KAMAYA	N/A	Chip Res, 1005 J 10KW
R102	KAMAYA	N/A	Chip Res, 1005 J 47KW
R103	KAMAYA	N/A	Chip Res, 1005 J 150KW
R104	KAMAYA	N/A	Chip Res, 1005 J 47KW
R105	KAMAYA	N/A	Chip Res, 1005 J 47KW
R106	KAMAYA	N/A	Chip Res, 1005 J 47KW
R107	KAMAYA	N/A	Chip Res, 1005 J 3.9KW
R108[1]	KAMAYA	N/A	Chip Res, 1005 J 4.7KW
R109[1]	KAMAYA	N/A	Chip Res, 1005 J 4.7KW
R110	KAMAYA	N/A	Chip Res, 1005 J 270KW
R112[1]	KAMAYA	N/A	Chip Res, 1005 J 4.7KW
R113	KAMAYA	N/A	Chip Res, 1005 J 47KW
R114	KAMAYA	N/A	Chip Res, 1005 J 10KW
R115	KAMAYA	N/A	Chip Res, 1005 J 10KW
R116	KAMAYA	N/A	Chip Res, 1005 J 1.2KW
R117	KAMAYA	N/A	Chip Res, 1005 J 8.2KW
R118	KAMAYA	N/A	Chip Res, 1005 J 47KW
R119[1]	KAMAYA	N/A	Chip Res, 1005 J 4.7KW
R120	KAMAYA	N/A	Chip Res, 1005 J 47KW
R121	KAMAYA	N/A	Chip Res, 1005 J 330KW
R122	KAMAYA	N/A	Chip Res, 1005 J 330KW
R126	KAMAYA	N/A	Chip Res, 1005 J 15KW
R127	KAMAYA	N/A	Chip Res, 1005 J 33KW
R128	KAMAYA	N/A	Chip Res, 1005 J 3.9KW
R129	KAMAYA	N/A	Chip Res, 1005 J 150KW
R131	KAMAYA	N/A	Chip Res, 1005 J 10W
R132	KAMAYA	N/A	Chip Res, 1005 J 1KW
R132	KAMAYA	N/A	Chip Res, 1005 J 220KW
R133	KAMAYA	N/A	Chip Res, 1005 J 680KW
R134	KAMAYA	N/A	Chip Res, 1005 J 3.9MW
R135	TDK	N/A	Chip Cap,1005 K 0.1µF
R136	KAMAYA	N/A	Chip Res, 1005 J 100KW
R137	KAMAYA	N/A	Chip Res, 1005 J 4.7MW
R138	KAMAYA	N/A	Chip Res, 1005 J 220KW
R139	KAMAYA	N/A	Chip Res, 1005 J 10KW
R140	KAMAYA	N/A	Chip Res, 1005 J 68KW
R141	KAMAYA	N/A	Chip Res, 1005 J 100KW
R142	KAMAYA	N/A	Chip Res, 1005 J 330KW
R143	KAMAYA	N/A	Chip Res, 1005 J 100KW
R144	KAMAYA	N/A	Chip Res, 1005 J 100KW
R145	KAMAYA	N/A	Chip Res, 1005 J 1MW
R146	KAMAYA	N/A	Chip Res, 1005 J 0W
R147	KAMAYA	N/A	Chip Res, 1005 J 47KW
R148	KAMAYA	N/A	Chip Res, 1005 J 1MW
R149	KAMAYA	N/A	Chip Res, 1005 J 470KW
R150	KAMAYA	N/A	Chip Res, 1005 F 10KW
R151	KAMAYA	N/A	Chip Res, 1005 F 12KW
R152	KAMAYA	N/A	Chip Res, 1005 J 680W
R153	KAMAYA	N/A	Chip Res, 1005 F 68KW
R154	KAMAYA	N/A	Chip Res, 1005 F 47KW
R155	KAMAYA	N/A	Chip Res, 1005 J 470W
R156	KAMAYA	N/A	Chip Res, 1005 J 1KW
R157[1]	KAMAYA	N/A	Chip Res, 1005 J 1KW
R158[1]	KAMAYA	N/A	Chip Res, 1005 J 1KW
R159	KAMAYA	N/A	Chip Res, 1005 J 47KW

Circuit Ref.	Supplier	Supplier Part No.	Description
R160	KAMAYA	N/A	Chip Res, 1005 J 47KW
R161	KAMAYA	N/A	Chip Res, 1005 J 47KW
R162	KAMAYA	N/A	Chip Res, 1005 J 820W
R163	KAMAYA	N/A	Chip Res, 1005 J 100KW
R164	KAMAYA	N/A	Chip Res, 1005 J 100KW
R165	KAMAYA	N/A	Chip Res, 1005 J 3KW
R167	KAMAYA	N/A	Chip Res, 1005 J 100KW
R168	KAMAYA	N/A	Chip Res, 1005 J 100KW
R169	KAMAYA	N/A	Chip Res, 1005 J 1.2KW
R171	KAMAYA	N/A	Chip Res, 1005 J 10KW
R172	KAMAYA	N/A	Chip Res, 1005 J 10KW
R173	KAMAYA	N/A	Chip Res, 1005 J 10KW
R174	KAMAYA	N/A	Chip Res, 1005 J 100KW
R175	KAMAYA	N/A	Chip Res, 1005 J 51KW
R176	KAMAYA	N/A	Chip Res, 1005 J 24KW
R177	KAMAYA	N/A	Chip Res, 1005 J 24KW
R178	KAMAYA	N/A	Chip Res, 1005 J 100KW
R179	KAMAYA	N/A	Chip Res, 1005 J 51KW
R180	KAMAYA	N/A	Chip Res, 1005 J 100KW
R181	KAMAYA	N/A	Chip Res, 1005 J 10W
R182	KAMAYA	N/A	Chip Res, 1005 J 200KW
R184	KAMAYA	N/A	Chip Res, 1005 J 15KW
R185	KAMAYA	N/A	Chip Res, 1005 J 0W
R190	KAMAYA	N/A	Chip Res, 1005 J 15KW
R193	KAMAYA	N/A	Chip Res, 1005 J 10KW
R194	KAMAYA	N/A	Chip Res, 1005 J 10KW
R195	KAMAYA	N/A	Chip Res, 1005 J 100W
R196	KAMAYA	N/A	Chip Res, 1005 J 47KW
R197	KAMAYA	N/A	Chip Res, 1005 J 47KW
R198	KAMAYA	N/A	Chip Res, 1005 J 47KW
R199	KAMAYA	N/A	Chip Res, 1005 J 47KW
R203	KAMAYA	N/A	Chip Res, 1005 J 22KW
R204	KAMAYA	N/A	Chip Res, 1005 J 22KW
R206	KAMAYA	N/A	Chip Res, 1005 J 10KW
R207	KAMAYA	N/A	Chip Res, 1005 J 22KW
R208	KAMAYA	N/A	Chip Res, 1005 J 12KW
R210	KAMAYA	N/A	Chip Res, 1005 J 120KW
R211	KAMAYA	N/A	Chip Res, 1005 J 15KW
R212	KAMAYA	N/A	Chip Res, 1005 J 47KW
R213	KAMAYA	N/A	Chip Res, 1005 J 3.3KW
R216	KAMAYA	N/A	Chip Res, 1005 J 10KW
R217	KAMAYA	N/A	Chip Res, 1005 J 10KW
R220	KAMAYA	N/A	Chip Res, 1005 J 3.9KW
R250	KAMAYA	N/A	Chip Res, 1005 J 10KW
R258	KAMAYA	N/A	Chip Res, 1005 J 1.5KW
R302	KAMAYA	N/A	Chip Res, 1005 J 56KW
R309	KAMAYA	N/A	Chip Res, 1005 J 8.2KW
R310	KAMAYA	N/A	Chip Res, 1005 J 5.6KW
R311	KAMAYA	N/A	Chip Res, 1005 J 330W
R312	KAMAYA	N/A	Chip Res, 1005 J 150KW
R314	KAMAYA	N/A	Chip Res, 1005 J 100W
R315	KAMAYA	N/A	Chip Res, 1005 J 100W
R316	KAMAYA	N/A	Chip Res, 1005 J 100KW
R317	KAMAYA	N/A	Chip Res, 1005 J 180KW
R318	KAMAYA	N/A	Chip Res, 1005 J 2.7KW
R319	KAMAYA	N/A	Chip Res, 1005 J 2.7KW
R320	KAMAYA	N/A	Chip Res, 1005 J 180W
R323	KAMAYA	N/A	Chip Res, 1005 J 100KW
R330	KAMAYA	N/A	Chip Res, 1005 J 100KW
R333	KAMAYA	N/A	Chip Res, 1005 J 100KW
R334	KAMAYA	N/A	Chip Res, 1005 J 100KW
R338	KAMAYA	N/A	Chip Res, 1005 J 100W
R339	KAMAYA	N/A	Chip Res, 1005 J 10W
R341	KAMAYA	N/A	Chip Res, 1005 J 100W
R342	KAMAYA	N/A	Chip Res, 1005 J 4.7KW
R343	TAIYOYUDEN	N/A	Chip Ind, 1005 J 2.2uH
R401	KAMAYA	N/A	Chip Res, 1005 J 180W
R402	KAMAYA	N/A	Chip Res, 1005 J 39W
R403	KAMAYA	N/A	Chip Res, 1005 J 180W
R404	KAMAYA	N/A	Chip Res, 1005 J 8.2KW
R405	KAMAYA	N/A	Chip Res, 1005 J 1.5KW
R406	KAMAYA	N/A	Chip Res, 1005 J 22W
R407	KAMAYA	N/A	Chip Res, 1005 J 4.7KW
R408	KAMAYA	N/A	Chip Res, 1005 J 2.2KW
R409	KAMAYA	N/A	Chip Res, 1005 J 10W
R410	KAMAYA	N/A	Chip Res, 1005 J 10W
R411	KAMAYA	N/A	Chip Res, 1005 J 560W
R412	KAMAYA	N/A	Chip Res, 1005 J 1KW
R413	KAMAYA	N/A	Chip Res, 1005 J 8.2KW
R414	KAMAYA	N/A	Chip Res, 1005 J 1KW
R415	KAMAYA	N/A	Chip Res, 2012 J 220W
R416	KAMAYA	N/A	Chip Res, 1608 J 47KW
R417	ROHM	N/A	Chip Res, 1W J 2512 0.1W
R418	KAMAYA	N/A	Chip Res, 1608 D 220KW
R419	KAMAYA	N/A	Chip Res, 1608 D 220KW
R420	KAMAYA	N/A	Chip Res, 1005 J 4.7MW
R421	KAMAYA	N/A	Chip Res, 1608 D 68KW
R422	KAMAYA	N/A	Chip Res, 1608 D 68KW
R423	KAMAYA	N/A	Chip Res, 1005 J 4.7MW
R424	KAMAYA	N/A	Chip Res, 1005 J 12KW
R425	KAMAYA	N/A	Chip Res, 1005 J 3.9KW
R426	KAMAYA	N/A	Chip Res, 1005 J 4.7KW
R427	KAMAYA	N/A	Chip Res, 1005 J 220KW
R428	KAMAYA	N/A	Chip Res, 1005 J 100W
R429	KAMAYA	N/A	Chip Res, 1005 J 3.6KW
R430	KAMAYA	N/A	Chip Res, 1005 J 100W

Circuit Ref.	Supplier	Supplier Part No.	Description
R431	KAMAYA	N/A	Chip Res, 1005 J 10KW
R432	KAMAYA	N/A	Chip Res, 1005 J 27KW
R433	KAMAYA	N/A	Chip Res, 1005 J 0W
R434	KAMAYA	N/A	Chip Res, 1005 J 33KW
R435	KAMAYA	N/A	Chip Res, 1005 J 150W
R436	KAMAYA	N/A	Chip Res, 1005 J 100W
R440	KAMAYA	N/A	Chip Res, 1005 J 15KW
R441	KAMAYA	N/A	Chip Res, 1005 J 0W
R501	KAMAYA	N/A	Chip Res, 1005 J 220W
R502	KAMAYA	N/A	Chip Res, 1005 J 220W
R503	KAMAYA	N/A	Chip Res, 1005 J 56KW
R504	NOBLE	N/A	CHIP SEMI V.R, 3PIE 47 KW
R505	KAMAYA	N/A	Chip Res, 1005 J 12KW
R506	KAMAYA	N/A	Chip Res, 1005 J 10KW
R507	KAMAYA	N/A	Chip Res, 1005 J 10KW
R508	KAMAYA	N/A	Chip Res, 1005 J 3.6KW
R509	KAMAYA	N/A	Chip Res, 1005 J 2.2KW
R510	KAMAYA	N/A	Chip Res, 1005 J 15KW
R511	KAMAYA	N/A	Chip Res, 1005 J 8.2KW
R512	KAMAYA	N/A	Chip Res, 1005 J 20KW
R513	KAMAYA	N/A	Chip Res, 1005 J 10KW
R514	KAMAYA	N/A	Chip Res, 1005 J 15KW
R515	KAMAYA	N/A	Chip Res, 1005 J 20KW
R516	KAMAYA	N/A	Chip Res, 1005 J 2.7KW
R517	KAMAYA	N/A	Chip Res, 1005 J 5.6KW
R518	KAMAYA	N/A	Chip Res, 1005 J 4.7KW
R519	KAMAYA	N/A	Chip Res, 1005 J 4.7MW
R520	KAMAYA	N/A	Chip Res, 1005 J 1MW
R521	KAMAYA	N/A	Chip Res, 1005 J 330KW
R523	KAMAYA	N/A	Chip Res, 1005 F 30KW
R524	KAMAYA	N/A	Chip Res, 1005 F 47KW
R526	NOBLE	N/A	CHIP SEMI V.R, 2PIE 47 KW
R527	KAMAYA	N/A	Chip Res, 1005 J 82KW
R528	KAMAYA	N/A	Chip Res, 1005 J 82KW
R529	KAMAYA	N/A	Chip Res, 1005 J 47KW
R530	KAMAYA	N/A	Chip Res, 1005 J 47KW
R531	KAMAYA	N/A	Chip Res, 1005 J 47KW
R532	KAMAYA	N/A	Chip Res, 1005 J 10KW
R533	KAMAYA	N/A	Chip Res, 1005 J 10KW
R534	KAMAYA	N/A	Chip Res, 1005 J 10KW
R535	KAMAYA	N/A	Chip Res, 1005 J 10KW
R536	KAMAYA	N/A	Chip Res, 1005 J 330KW
R537	KAMAYA	N/A	Chip Res, 1005 J 1KW
R538	KAMAYA	N/A	Chip Res, 1005 J 6.8KW
R539	KAMAYA	N/A	Chip Res, 1005 J 330KW
R540	KAMAYA	N/A	Chip Res, 1005 J 47KW
R541	KAMAYA	N/A	Chip Res, 1005 J 330KW
R609	KAMAYA	N/A	Chip Res, 1005 J 1KW
R610	KAMAYA	N/A	Chip Res, 1005 J 2.2W
R613	KAMAYA	N/A	Chip Res, 1005 J 15KW
R614	KAMAYA	N/A	Chip Res, 1005 J 390KW
R615	KAMAYA	N/A	Chip Res, 1005 J 2.2W
R616	KAMAYA	N/A	Chip Res, 1005 J 0W
R619	KAMAYA	N/A	Chip Res, 1005 J 10KW
R620	KAMAYA	N/A	Chip Res, 1005 J 33KW
R621	KAMAYA	N/A	Chip Res, 1005 J 39KW
R622	KAMAYA	N/A	Chip Res, 1005 J 0W
R623	KAMAYA	N/A	Chip Res, 1005 J 560W
R701	KAMAYA	N/A	Chip Res, 1005 J 56W
R702	KAMAYA	N/A	Chip Res, 1005 J 1.5KW
R703	KAMAYA	N/A	Chip Res, 1005 F 4.7KW
R704	KAMAYA	N/A	Chip Res, 1005 F 4.7KW
R705	KAMAYA	N/A	Chip Res, 1005 J 220W
R706	KAMAYA	N/A	Chip Res, 1005 J 100W
R707	KAMAYA	N/A	Chip Res, 1005 J 1.5KW
R708	KAMAYA	N/A	Chip Res, 1005 F 4.7KW
R709	KAMAYA	N/A	Chip Res, 1005 F 6.8KW
R710	KAMAYA	N/A	Chip Res, 1005 J 220W
R711	KAMAYA	N/A	Chip Res, 1005 J 100KW
R712	KAMAYA	N/A	Chip Res, 1005 J 100KW
R713	KAMAYA	N/A	Chip Res, 1005 J 30KW
R714	KAMAYA	N/A	Chip Res, 1005 J 56W
R715	KAMAYA	N/A	Chip Res, 1005 J 56W
R716	KAMAYA	N/A	Chip Res, 1005 J 330W
R717	KAMAYA	N/A	Chip Res, 1005 J 10W
R718	KAMAYA	N/A	Chip Res, 1005 J 7.5KW
R719	KAMAYA	N/A	Chip Res, 1005 J 1KW
R720	KAMAYA	N/A	Chip Res, 1005 J 150W
R721	KAMAYA	N/A	Chip Res, 1005 J 150W
R722	KAMAYA	N/A	Chip Res, 1005 J 10KW
R723	KAMAYA	N/A	Chip Res, 1005 J 1KW
R724	KAMAYA	N/A	Chip Res, 1005 J 390W
R725	KAMAYA	N/A	Chip Res, 1005 J 100W
R726	KAMAYA	N/A	Chip Res, 1005 J 3KW
R727	KAMAYA	N/A	Chip Res, 1005 J 2.7KW
R728	KAMAYA	N/A	Chip Res, 1005 J 2.7KW
R729	KAMAYA	N/A	Chip Res, 1005 J 100KW
R730	KAMAYA	N/A	Chip Res, 1005 J 33KW
R731	KAMAYA	N/A	Chip Res, 1005 J 10W
R732	KAMAYA	N/A	Chip Res, 1005 J 10KW
R733	KAMAYA	N/A	Chip Res, 1005 J 0W
R734	KAMAYA	N/A	Chip Res, 1005 J 10W
R735	KAMAYA	N/A	Chip Res, 1005 J 1KW
R736	KAMAYA	N/A	Chip Res, 1005 J 1KW
R737	KAMAYA	N/A	Chip Res, 1005 J 1KW
R740	KAMAYA	N/A	Chip Res, 1005 J 1.5KW

Circuit Ref.	Supplier	Supplier Part No.	Description
R1001	KAMAYA	N/A	Chip Res, 1005 J 10KW
R1002	KAMAYA	N/A	Chip Res, 1005 J 9.1KW
R1003	KAMAYA	N/A	Chip Res, 1005 J 8.2KW
R1004	KAMAYA	N/A	Chip Res, 1005 J 10KW
R1005	TDK	N/A	Chip Cap,1005 K 10nF
RT201	TAIYOYUDEN	N/A	Thermistor, 103K
RT501	TAIYOYUDEN	N/A	Thermistor, 103K
SH101	BGTech	8860BEACA1010	Shield CAN, VCO
SH102	BGTech	8860BEAC93010	Shield CAN, PLL
SH103	BGTech	8660BEACA4010	Shield CAN, PA
SH104	MOTOROLA	PMDN4150AR	Finger Strip, T PCB
SH105	MOTOROLA	PMDN4149AR	Finger Strip TX
SH201	MOTOROLA	PMDN4151AR	Finger Strip – Pair
SH202	MOTOROLA	PMDN4152AR	Finger Strip - Single SMD
SPK1	BGTech	8400362424100	Speaker, 24W 1.0W 36q(Connector type)
SW/ VOL1	BGTech	84766N992N151	TOKOS, Switch Volume RY-8418
U101	BGTech	81100303RF020	CPU IC
U102	BGTech	8116AK2347020	AUDIO LSI, AK2347
U103	BGTech	8192088L70020	DTMF RECEIVER, MT88L70
U104	BGTech	811324LC64020	EEPROM IC, 24LC64
U105	BGTech	8124000324011	OP AMP, NJM324
U106	BGTech	8135TC7S66020	Analog SW IC, TC7S66FU
U107	BGTech	81287027AT020	VOLTAGE DETECTOR, KIA7027AT
U201	BGTech	8125311360020	FM IC, TA31136
U202	BGTech	8191401150220	DIGITAL POTENTIOME-TER, MCP4011(502)
U401	BGTech	8124000358011	OP AMP (DUAL), KIA358
U402	BGTech	8191401150220	DIGITAL POTENTIOME-TER, MCP4011(502)
U501	BGTech	8124000324011	OP AMP, NJM324
U502	BGTech	8124000324011	OP AMP, NJM324
U505	BGTech	8123011250021	REGULATOR IC, TK11250AMTL
U506	BGTech	8123011233020	REGULATOR IC, TK11233AMTL
U507	BGTech	8128TC1240020	VOLTAGE DOUBLER, TC1240
U508	BGTech	8191401150320	DIGITAL POTENTIOME-TER, MCP4011(503)
U601	BGTech	811608541T020	AUDIO AMP, TDA8541
U701	BGTech	810415E03S020	PLL IC, MB15E03SLPFV1-G-BND-EF-6
PCB1	BGTech	8431BEAUHF300	CAFSYSTEM, Main PCB, FR4 4 Layer PCB
SUB PCB1	BGTech	8421BEACON100	CAFSYSTEM, Sub PCB, 1.2T 2 Layer
KEY PCB1	BGTech	8422BEACON100	CAFSYSTTEM, Key PCB, 1.2T 2Layer

Note:
1: Not for PMUE3323AAL

Appendix A Warranty, Service Support, and Replacement Parts

A.1 Scope of Manual

This manual is intended for use by service technicians familiar with similar types of equipment. It contains service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date may be incorporated by a complete Manual revision or alternatively as additions.

Note: Before operating or testing these units, please read the Product Safety and RF Exposure Compliance section in the front of this manual.

A.2 Warranty

A.2.1 What This Warranty Covers And For How Long

MOTOROLA INC. (“MOTOROLA”) warrants the MOTOROLA manufactured Communication Products listed below (“Product”) against defects in material and workmanship under normal use and service for a period of time from the date of purchase as scheduled below:

Table A-1. Portable Radios and Product Accessories Warranty

EP350 Portable Radios	Two (2) Years
Product Accessories (including Batteries and Chargers)	One (1) Year

Motorola, at its option, will at no charge either repair the Product (with new or reconditioned parts), replace it (with a new or reconditioned Product), or refund the purchase price of the Product during the warranty period provided it is returned in accordance with the terms of this warranty. Replaced parts or boards are warranted for the balance of the original applicable warranty period. All replaced parts of Product shall become the property of MOTOROLA.

This express limited warranty is extended by MOTOROLA to the original end user purchaser only and is not assignable or transferable to any other party. This is the complete warranty for the Product manufactured by MOTOROLA. MOTOROLA assumes no obligations or liability for additions or modifications to this warranty unless made in writing and signed by an officer of MOTOROLA. Unless made in a separate agreement between MOTOROLA and the original end user purchaser, MOTOROLA does not warrant the installation, maintenance or service of the Product.

MOTOROLA cannot be responsible in any way for any ancillary equipment not furnished by MOTOROLA which is attached to or used in connection with the Product, or for operation of the Product with any ancillary equipment, and all such equipment is expressly excluded from this warranty. Because each system which may use the Product is unique, MOTOROLA disclaims liability for range, coverage, or operation of the system as a whole under this warranty.

A.2.2 General Provisions

This warranty sets forth the full extent of MOTOROLA'S responsibilities regarding the Product. Repair, replacement or refund of the purchase price, at MOTOROLA's option, is the exclusive

remedy. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER EXPRESS WARRANTIES. IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS LIMITED WARRANTY. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT, FOR ANY LOSS OF USE, LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS OR SAVINGS OR OTHER INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE SUCH PRODUCT, TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW.

A.2.3 How To Get Warranty Service

You must provide proof of purchase (bearing the date of purchase and Product item serial number in order to receive warranty service and, also, deliver or send the Product item, transportation and insurance prepaid, to an authorized warranty service location. Warranty service will be provided by Motorola through one of its authorized warranty service locations. If you first contact the company which sold you the Product, it can facilitate your obtaining warranty service. You can also open a Contact Us case on Motorola Online (www.motorola.com/businessonline).

A.2.4 What This Warranty Does Not Cover

- Defects or damage resulting from use of the Product in other than its normal and customary
- manner.
- Defects or damage from misuse, accident, water, or neglect.
- Defects or damage from improper testing, operation, maintenance, installation, alteration,
- modification, or adjustment.
- Breakage or damage to antennas unless caused directly by defects in material workmanship.
- A Product subjected to unauthorized Product modifications, disassemblies or repairs (including,
- without limitation, the addition to the Product of non-Motorola supplied equipment) which
- adversely affect performance of the Product or interfere with Motorola's normal warranty
- inspection and testing of the Product to verify any warranty claim.
- Product which has had the serial number removed or made illegible.
- Rechargeable batteries if:
  - any of the seals on the battery enclosure of cells are broken or show evidence of tampering.
  - the damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.
- Freight costs to the repair depot.
- A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product,
- does not function in accordance with MOTOROLA’s published specifications or the FCC
- type acceptance labeling in effect for the Product at the time the Product was initially distributed
- from MOTOROLA.
- Scratches or other cosmetic damage to Product surfaces that does not affect the operation of
- the Product.
- Normal and customary wear and tear.

A.2.5 Patent And Software Provisions

MOTOROLA will defend, at its own expense, any suit brought against the end user purchaser to the extent that it is based on a claim that the Product or parts infringe a United States patent, and MOTOROLA will pay those costs and damages finally awarded against the end user purchaser in any such suit which are attributable to any such claim, but such defense and payments are conditioned on the following:

- that MOTOROLA will be notified promptly in writing by such purchaser of any notice of such claim
- that MOTOROLA will have sole control of the defense of such suit and all negotiations for its settlement or compromise
- should the Product or parts become, or in MOTOROLA's opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit MOTOROLA, at its option and expense, either to procure for such purchaser the right to continue using the Product or parts or to replace or modify the same so that it becomes noninfringing or to grant such purchaser a credit for the Product or parts as depreciated and accept its return. The depreciation will be an equal amount per year over the lifetime of the Product or parts as established by MOTOROLA.

MOTOROLA will have no liability with respect to any claim of patent infringement which is based upon the combination of the Product or parts furnished hereunder with software, apparatus or devices not furnished by MOTOROLA, nor will MOTOROLA have any liability for the use of ancillary equipment or software not furnished by MOTOROLA which is attached to or used in connection with the Product. The foregoing states the entire liability of MOTOROLA with respect to infringement of patents by the Product or any parts thereof.

Laws in the United States and other countries preserve for MOTOROLA certain exclusive rights for copyrighted MOTOROLA software such as the exclusive rights to reproduce in copies and distribute copies of such Motorola software. MOTOROLA software may be used in only the Product in which the software was originally embodied and such software in such Product may not be replaced, copied, distributed, modified in any way, or used to produce any derivative thereof. No other use including, without limitation, alteration, modification, reproduction, distribution, or reverse engineering of such MOTOROLA software or exercise of rights in such MOTOROLA software is permitted. No license is granted by implication, estoppel or otherwise under MOTOROLA patent rights or copyrights.

A.2.6 Piece Parts

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola part number is assigned to the part, it is available from Motorola's Managed Technical Services (MTS). If no part number is assigned, the part is not normally available from Motorola. If the part number is appended with an asterisk, the part is serviceable by Motorola Depot only. If a parts list is not included, this generally means that no user-serviceable parts are available for that kit or assembly.

All orders for parts/information should include the complete Motorola identification number. Request for help in identification of non-referenced spare parts should be directed to the Motorola's local area representation. When damaged parts are replaced, identical parts should be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola part number. Orders for replacement parts which are listed in the "Parts List" section of this manual, should be placed directly on Motorola's local distribution organization or via Motorola Online (Extranet).

Glossary of Terms

Term	Definition
ALC	Automatic Level Control: a circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR (Voltage Standing Wave Ratio).
ASFIC	Audio Signalling Filter Integrated Circuit
BKC	Bad Key Chirp
CD	Compact Disk
CMP	Compression
CPS	Customer Programming Software
CSQ	Carrier Squelch
DTMF	Dual-Tone Multifrequency
DPL	Digital Private-Line™
EEPROM	Electronically Erasable/Programmable Read-Only Memory: used by the radio to store its personality
EPP	Environmental Preferred Product
Firmware	Software, or a software/hardware combination of computer programs and data, with a fixed logic configuration stores in a read-only memory. Information cannot be altered or reprogrammed.
FGU	Frequency Generation Unit
GaAs	Gallium Arsenide: a type of crystalline material used in some semiconductors.
GKC	Good Key Chirp
ISW	Inbound Signalling Word: data transmitted on the control channel from a subscriber unit to the central control unit.
LH DATA	Longhorn Data: a bidirectional 0-5V, RS-232 line protocol that uses the microcontroller's integrated RS-232 asynchronous serial communications interface (SCI) peripheral.
LLE	Low Level Expander: slight amount of volume expansion; used to improve the signal to noise ratio.
MCU	Micro Controller Unit
MRTI	Motorola Radio-Telephone Interconnect: a system that provides a repeater connection to the Public Switched Telephone Network (PSTN). The MRTI allows the radio to access the telephone network when the proper access code is received.
OMPAC	Over-Molded Pad-Array Carrier: a Motorola custom package, distinguished by the presence of solder balls on the bottom pads.
PC Board	Printed Circuit Board

Term	Definition
PL	Private-Line® tone squelch: a continuous sub-audible tone that is transmitted along with the carrier.
PLL	Phase-Locked Loop: a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PTT	Push-To-Talk: the switch located on the left side of the radio; when pressed, causes the radio to transmit.
RAM	Random Access Memory: the radio's RAM is loaded with a copy of the EEPROM data.
Registers	Short-term data-storage circuits within the microcontroller.
RESET	Reset line: an input to the microcontroller that restarts execution.
RF PA	Radio Frequency Power Amplifier
ROM	Read Only Memory
RSSI	Received Signal-Strength Indicator: a dc voltage proportional to the received RF signal strength.
RPT/TA	Repeater/Talk-Around
Softpot	A computer-adjustable electronic attenuator
Software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
SPI (clock and data lines)	Serial Peripheral Interface: how the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.
Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value.
Standby Mode	An operating mode whereby the radio is muted but still continues to receive data
TOT	Time-Out Timer: a timer that limits the length of a transmission.
TPL	Tone Private-line
µC	Microcontroller
µP	Microprocessor
UHF	Ultra High Frequency
VCO	Voltage-Controlled Oscillator: an oscillator whereby the frequency of oscillation can be varied by changing a control voltage.
VCOBIC	Voltage-Controlled Oscillator Buffer Integrated Circuit
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio

MOTOROLA

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